PROJECT BRIEF

1. IDENTIFIERS

PROJECT NUMBER :	
PROJECT NAME:	**Wind Power Development Project in the People's Republic of China (PRC)**
PROJECT DURATION:	3 years
IMPLEMENTING AGENCY:	United Nations Development Programme (UNDP)
EXECUTING AGENCY:	Asian Development Bank (ADB)
NATIONAL COORDINATING AGENCY:	State Development Planning Commission (SDPC)
REQUESTING COUNTRY:	People's Republic of China (PRC)
ELIGIBILITY:	***The PRC ratified the UNFCCC on January 5, 1993***
GEF FOCAL AREA:	Climate Change
GEF PROGRAMMING FRAMEWORK:	Operational Programme No. 6: Promoting the Adoption of Renewable Energy by Removing Barriers and Reducing Implementation Costs

2. SUMMARY:

This Project aims to reduce GHG emissions by accelerating the growth of large-scale grid-connected wind power development to replace current fossil fuel consumption in the PRC. The objectives of the Project are to a) remove the policy, information, and institutional barriers to wind power development to promote wide replication of wind power commercialization in the PRC; and b) facilitate the implementation of three wind farms to be financed by ADB through GEF contingent loan support which will reduce performance risks associated with the deployment of this new technology and accelerate commercialization of wind farms in the PRC. This Project will adopt a bottom-up approach to complement the overall national policy framework that is expected to be developed by the Government under its partnership program for renewable energy development and for which assistance is expected to be provided by GEF, the World Bank, and ADB. The Project will focus primarily on acceleration of commercialization of wind power development in the three provinces selected for the ADB-financed Project, and then promote and disseminate these provincial experiences and lessons across the nation.

3. COSTS AND FINANCING (MILLION US$)

GEF:	US$ 12.0 million
CO-FINANCING:	
ADB:	US$ 58.0 million
Provincial Power Companies:	US$ 18.5 million
Domestic Banks:	US$ 10.2 million
TOTAL PROJECT COSTS:	**US$ 98.7 million**

4. OPERATIONAL FOCAL POINT ENDORSEMENT

Name: Mr. Yang Jinlin — Title: GEF Operational Focal Point
Organization: Ministry of Finance — Date: 26 June, 2000

5. GEF Executing Agency/Implementing Agency Contacts

Asian Development Bank: Edu Hassing, Mission Leader, ADB, tel 632-6326544; fax 632-636 2444; email ehassing@adb.org

United Nations Development Programme: Richard Hosier, Task Manager, tel 1 212 906 6033; fax 1 212 906 6998; email: richard.hosier@undp.org

PRC: WIND POWER DEVELOPMENT PROJECT (THE PROJECT)

RESPONSE TO GEF PROJECT REVIEW CRITERIA

IV. I. COUNTRY OWNERSHIP

A. Country Eligibility

1. The People's Republic of China (PRC) ratified the FCCC on 5 January 1993.

B. Country Drivenness

2. Renewable energy incentive policies in the PRC include two levels: central governmental policy and local governmental policy. The central governmental policy provides guidelines at the macro-level, while local government policies are detailed implementation policies. However, an appropriate central government policy framework only could create the appropriate conditions for large-scale renewable energy projects to develop in the PRC.

3. Central Government policies to promote renewable energy development include three categories. The first category concerns general macro policies, such as the Program on New and Renewable Energy Development in the PRC (1996-2010) jointly prepared by the State Development Planning Commission (SDPC), Ministry of Science & Technology (MOST) and State Economic & Trade Commission (SETC). The Program provided the objectives and targets of renewable energy development in the PRC. As part of this program, the Government gives priority to grid-connected wind power development, and sets a target of 300-400 MW of installed capacity of wind power by the year 2000, and 1,000-1,100 MW by 2010. Given the latest development and plans from the major wind-producing provinces, the SETC and State Power Corporation (SP) recently updated their objectives and proposed more ambitious targets for wind power development in the PRC, as shown in Table 1. The 1995 Electricity Law also extends support to the solar, wind, geothermal, and biomass energy for power generation.

Table 1: Target of Wind Power Development in the PRC

	1998	2000	2005	2010	2015
"Program"	224	300-400		1,000-1,100	
SETC	224	740	3,000	4,900	7,000
State Power	224	763	3,117	5,066	7,313

Source: the "Program", SETC and State Power Corporation.

4. The second category concerns the government regulations prepared by the associated administration ministries and commissions. The three major regulations to support grid-connected wind power development are the following:

(i) In 1994, the Ministry of Electric Power issued the "Regulation on Large Scale Wind Power Connected to Grid" as the first mandatory regulation for wind power development. The regulation specified that the grid must purchase all the wind power generation. The power purchase price of wind power should be based on

the debt repayment pricing principle and include VAT. The debt repayment pricing includes operating cost, repayment of loan capital with interest, and reasonable profit. The difference of the wind power purchase price and the grid average power price should be shared by the whole grid, but the regulation did not clearly specify the scope of the grid -- provincial, regional, or national grid.

(ii) In January 1999, SDPC and MOST jointly issued No. 44 document to further support renewable energy development. This regulation defined renewable energy, proposed investment subsidy measures for renewable energy projects through State Development Bank (SDB), and clarified the project approval procedure.

(iii) In November 1999, SETC issued another regulation to further promote wind power development in the PRC. For the first time, it specified that the price difference between the wind power and grid average price should be shared by the provincial grid, and encouraged wind power sales between the provincial grids.

(iv) In November 1999, SDPC announced its plan to establish under its tenth five year plan (TFYP) from 2001-2006 a Strategic Partnership for Renewable Energy with the main objective to reduce environmental emissions from coal-fired power generation by developing sustainable commercial markets for electricity from renewable energy. It is expected that GEF/World Bank assistance for the partnership will be considered by GEF in May 2001.

5. The Government also provides investment subsidies for renewable energy projects, such as the “Wind Plan” to support domestic manufacturing of wind turbines and the “Sunshine Plan” to encourage off-grid wind and solar PV for rural electrification by SDPC, and the “Foreign Capital Utilization Policy” and the “Double Push” investment in renewable energy by SETC. Local government policies could include investment subsidy, power purchase price subsidy, and taxation subsidy at the provincial level to support the renewable energy development.

C. Country Operational Focal Point

6. The National Operational Focal Point for GEF in the PRC is Mr. Yang Jinlin of the Ministry of Finance (MOF), who has endorsed the proposed Project. The letter of endorsement was signed on 26 June, 2000, and is in Appendix 18 of the Project Brief.

II. PROGRAM AND POLICY CONFORMITY

A. Program Designation

7. The GEF Secretariat (GEFSec) has recommended the Project for work program inclusion under Operational Program (OP) #6 on Promoting the Adoption of Renewable Energy by Removing Barriers and Reducing Implementation Costs as an intervention that supports the objectives of the envisaged GEF assistance for the Strategic Partnership for Renewable Energy of SDPC.

B. Program Conformity

8. Development of grid-connected wind-based power generation as envisaged under the Project is a key objective of OP#6 and the Government's Strategic Partnership for Renewable Energy Development. The PRC has a rich wind resource base, and "world class" wind resources at wind farm sites. The Project conforms to the Operational Program and with its status of implementation, as set out in the *GEF Corporate Business Plan*. The Project will contribute to creating a firmer market for the supply of wind turbines which would make it economical for overseas manufacturers of wind turbines to transfer their assembly and manufacturing operations to the PRC thereby lowering the costs of the wind turbines. Also, the Project's demonstration effect with regard to the efficient construction and operation of wind farms will promote the development of additional grid-based wind farms.

C. Baseline Development Path

9. Despite the PRC's considerable national wind resource potential of more than 250 gigawatts (GW) the total installed capacity of grid-connected wind farms was about 265 MW only by the end of 1999. Most of them have an installed capacity of less than 20 MW and have been built with financial assistance through Government subsidies and/or soft loans from bilateral agencies and financing of wind farms on a commercial basis and with private sector involvement has not yet begun in a serious manner. The baseline path consists of what the Government would do without GEF support. Under the baseline, a number of barriers exist to the large-scale grid-connected wind power development in the PRC. These barriers comprise (i) high costs of wind-based electricity; (ii) lack of specific regulations for full payment of the price difference between conventional electricity and wind-based electricity; (iii) lack of competition for developers of wind-based power generation projects; (iv) lack of standard financial evaluation methods to determine tariffs for wind-based electricity; (v) limited market-oriented framework for development of wind-based power generation projects; and (vi) lack of reliable high-quality site-specific wind data. Without the removal of these barriers through this Project, the wind power market will remain undeveloped and the share of wind-based power in the national power mix is likely to remain negligible. Although the Government has begun promoting the use of alternative energy sources to replace coal and improve energy efficiency, coal is still likely to continue to provide two thirds of the PRC's commercial energy in 2020. This corresponds to a three-fold increase in coal consumption by the year 2020, and would lead to a threefold increase in GHG emissions by 2020. The US Energy Information Administration (EIA) has projected that the PRC will become the world's largest carbon emitter before the year 2020.

D. Global Environmental Benefits and Alternative Development Path

10. In this context the global environmental objective of the Project is the reduction of GHG emissions by removing major barriers to the development of wind-based power generation projects to replace fossil fuel use in the PRC. However, without the removal of such barriers through the Project it is unlikely that a widespread national program of replication of wind-based power generation will take place. Under the alternative development path the Project with GEF support will play a catalytic role in helping the PRC to begin capturing its enormous potential for wind-based power generation in a sustainable and efficient manner. GEF support is required for the following activities:

(i) Activity 1 is designed to decrease the wind power tariffs. This activity will develop a standard financial evaluation method specifically for calculating wind power tariffs, and estimate an appropriate wind power tariff benchmark level as an upper limit for wind power pricing approval. It will also improve the incentive regulations that clearly spell out the financing schemes and develop a mechanism for full compensation of the electricity distributors of the price difference between the wind-based electricity and the grid average price. It will hold wide consultations with key stakeholders to reach an agreement in this regard. Finally, this activity will provide training at the provincial level in the standard financial evaluation method for wind power tariff and implementation of standard power purchase agreement. This activity is targeted to remove the financial barriers (ii) and (iv), thereby making wind power more competitive and attractive.

(ii) Activity 2 is intended to develop a competitive institutional model for development of wind-based power generation projects. It will identify options for private sector involvement in the three wind farms under the Project and provide technical assistance in restructuring of existing wind power companies at Dabancheng, in the Xinjiang Autonomous Region. This activity aims to introduce competition in the development wind-based power generation facilities thereby decreasing wind-based electricity costs in the PRC. It is designed to remove the economic and institutional barriers (i) and (iii).

(iii) Activity 3 will assist the three provinces under the Project—the Xinjiang Autonomous Region and Liaoning and Heilongjiang provinces—in formulating and implementing market-oriented renewable energy policies, within the national renewable energy policy framework. It will assist in developing provincial wind power development plans; identifying options for development of provincial market-oriented wind power policies; developing RPS targets and implementation plans for wind power in the three provinces; and in conducting feasibility studies for green certificate trading. This activity is designed to directly remove the policy barrier (v) and facilitate future replication of wind power in The PRC.

(iv) Activity 4 will involve conducting wind measurements at 25 promising sites in six selected provinces, transfer wind measurement data into the national wind resource database, as well as develop competitive bidding procedures for potential wind farm developers who may be interested to invest at these potential wind sites. This activity is designed to provide reliable site-specific wind resource information to the potential investors, hence reducing the transaction costs for potential wind developers and facilitating future investment in wind power. This will directly remove the information barrier (vi). This activity is also targeted to promote economies of scale with regard to development of new wind farms and introduce competition among potential wind farm developers. It is expected to create a larger and firmer market for wind turbine manufactures and promote technology transfer and the development of a domestic wind turbine manufacturing industry, thereby reducing the costs of wind-based power

generation and removing the economic barriers (i) and (iii). This activity is crucial to remove both the information and economic barriers and facilitate future replication of wind power projects in the PRC.

(v) Activity 5 will strengthen the evaluation capabilities of provincial decision-makers and increase their awareness and support with regard to wind power development. It will also strengthen the business development and management skills of staff of the wind farm companies.

(vi) Activity 6 will promote and disseminate at the national level the experience and lessons learned from the previous activities. This will further remove the information barrier and facilitate the larger replication of wind power development nationwide.

(vii) Activity 7 includes the provision of a GEF contingent loan to the respective provincial power companies, which will act as Executing Agency for the construction of the concerned wind, farm. The contingent loan will have no interest charges and will need to be repaid after ten years following completion of the wind farms if the Project is successful. However, if the wind farms are not successful, the loan will become a grant. Use of the contingent loan constitutes an innovative tool that is provided to share with the wind farm companies perceived performance risks associated with wind farms and build confidence in the new technology. These performance risks comprise lower than expected wind speeds (wind resource risk) and wind turbine reliability in view of the new technology and operation and maintenance procedures being applied as well as the present inadequate local availability of technical support from overseas wind turbine manufacturers in a fledgling market for grid-connected wind farms (technology risk). Experience in the PRC shows that the operation and maintenance of wind farms have often not been up to international standards and that sometimes wind farms have been constructed on the basis of overly optimistic assumptions with regard to the expected wind speeds which has resulted in lower energy outputs than originally calculated in the feasibility studies and subsequent losses to the developers. For the three Executing Agencies, construction of the three wind farms will be the first large-scale grid-connected commercial wind farm construction financed from ADB's ordinary capital resources at normal interest rates, which they therefore perceive as riskier investments than equivalent investments in fossil-fuel power plants. Also, under the Project options will be evaluated for increasing private sector participation in the wind farms in the future and the inclusion of a contingent loan in the financing arrangements for the wind farms is expected to promote the interest of the private sector in such participation.

E. Replicability

11. The Project's potential for replicability in other parts of the PRC is very good since the Project constitutes a bottom-up approach within the overall policy framework that is envisaged to be developed by the Government under its Partnership Program for Renewable Energy Development for which assistance is expected to be provided by GEF, the World Bank, and ADB. Technical assistance for barrier removal and institutional strengthening will facilitate such replicability since it will create at provincial levels the required institutional, policy, and technical

conditions to enable the mobilization of funds for the development of additional wind farms. In addition, as mentioned above Activity 6 will promote and disseminate lessons learned at provincial level at the national level.

F. Sustainability

12. From a technical point of view, the technical feasibility of grid-connected wind power technologies has been proven in both the international market and the PRC context. In anticipation of a separate market for renewable energy, which is expected to be established under the Government's TFYP but will require at least a few more years from now before it will become operational, the Project will help create a sustainable demand for wind farms through building local capacity, supporting three wind farms, and disseminating information. These efforts should ensure the long-term sustainability of wind power technology in the PRC.

13. From a financial point of view, the Project will first help improve the wind power tariff structure, decrease the wind power tariffs in the PRC, and clearly establish a mechanism to fully pay the provincial power companies for the price difference between wind-based electricity and conventional electricity. Subsequently, it will help introduce competition by developing a competitive institutional model for wind power project development for both the three wind farms under the Project as well as subsequent wind farms that would be constructed at some of the 25 selected promising sites where wind measurements will be conducted. These measures will cause a decrease in the cost of wind-based power generation in the PRC. Further, the Project will provide training to wind farm companies in business development and management skills to reduce the operating costs for the wind farms. It will also develop market-oriented renewable energy policies and implementation action plans for the provinces to provide additional incentive policies and market-mechanisms to promote commercialization of wind power development in the PRC and will make high-quality site-specific wind measurement data available to potential investors to attract increased investments in wind power development in the PRC.

14. From an institutional point of view, the Project will strengthen the evaluation capabilities of provincial decision-makers and increase their awareness and support with regard to wind power development in the PRC. The Project will also make recommendations for development of a competitive institutional model for development of wind power projects in the PRC. All these efforts will ensure the institutional sustainability.

G. Public Involvement

15. Public involvement in the Project has been assured. During the Project preparation stage extensive discussions were held with local stakeholders and socioeconomic profiles were prepared for all sites and all local communities support the development of the wind farms. All sites are uninhabited and adequate compensation will be paid to original users of the land. At the site of the wind farm in the Xinjiang Autonomous Region, Kazakhs ethnic minority herdsmen have been using the land of the site for cattle grazing during the seasons when grass is available. They will be compensated for the reduced grass available to them under an *Ethnic Minority Development Plan, which* is being prepared in accordance with ADB's *Policy on Indigenous Peoples*. The dissemination at the national level of the experience and lessons learned under the technical assistance for barrier removal and institutional strengthening will

also ensure that a wide audience interested in the further development of wind-based power in the PRC will be able to learn from the Project.

H. Private Sector Involvement

16. The Project is also expected to be instrumental in promoting private sector investments in wind farms in the PRC. Under the Project feasibility studies on options for attracting private investors and nongovernment investment funds in the wind farms will be undertaken to facilitate the mobilization of such financing. Also, competitive bidding procedures will be developed to attract potential wind farm developers who may be interested to invest at any of the 25 potential wind sites where wind measurements will be conducted.

I. Monitoring, Evaluation, and Indicators

17. The Project will be monitored and evaluated in line with ADB rules and procedures and the GEF guidelines for M&E. ADB will undertake this activity with cooperation from UNDP, the GEF focal point ministry in the PRC, MOF, and the National Coordinating Agency of the Project (SDPC). ADB's extensive experience in monitoring large projects will be drawn upon to ensure that all Project activities are carefully recorded, documented, and accounted for. Data will be collected on the key performance indicators and results of the monitoring and evaluation surveys will be used to implement changes to the Project, if necessary and for future reference in the development of similar projects. Annual Performance Reports will be prepared and discussed with the national coordinating agency, the Executing Agencies, and Project staff. For the technical assistance the progress of the various barrier removal and institutional strengthening activities will be discussed in semi-annual Tripartite Review meetings with the National Coordinating Agency, the Executing Agencies, consultants, and ADB, so as to take the necessary action to improve and maximize Project impact and implementation. The Project will be subject to at least two or three external evaluations. The contingent loan is to be repaid in full after ten years following completion of wind farms if the Project is successful. The Project is considered successful if during the three years prior to repayment all wind farms have achieved an availability of more than 95 percent, complied with the financial covenants, and made a reasonable profit. If the Project is not successful, repayment of the GEF contingent loan is not required only if it has been established that the failure of the Project to become successful is due to wind resource and/or technology deficiencies that were beyond the control of the wind farm operators.

18. ADB will undertake continuous monitoring of the Project activities through regular Review Missions, submission of Quarterly Progress Reports and annual Audited Financial Statements by the Executing Agencies, and consultants' reports. ADB will also carefully monitor the external conditions related to the critical assumptions listed in the Project's logical framework as shown in Appendix 1 of the Project Brief. At the outset, detailed and measurable performance indicators for the overall Project will be prepared by ADB in consultation with UNDP, MOF, SDPC, and other concerned stakeholders. These performance indicators will be assessed every six months. The indicators will apply not only to project activities, but also to progress made in the implementation of the pilot wind farms and other potential sites. In particular, ADB will develop the benchmark indicators of success for the three wind farms, conduct monitoring and evaluation of the performance of the three wind farms, and ensure the repayment of GEF contingent loan after 10 years following completion of the wind farms. Based on the overall Project objectives and these performance indicators, quarterly work plans will be

prepared. These will indicate how the quarter's activities contribute to the overall objectives. In addition, this monitoring will be used to continuously refine the Project's approach and activities. The performance of the wind farms will be strictly evaluated against targets and milestones as agreed with the Government in line with ADB's normal procedures for benefit evaluation and monitoring of its projects.

J. Lessons

19. The design of the Project has drawn lessons from previous UNDP/GEF sponsored wind projects. To date, the first lesson learned is the importance of an appropriate level of power purchase price and priority dispatch in the power purchase agreement (PPA) to ensure the financial viability of the wind farms. Appropriate PPAs for the wind farms under the Project will need to have been developed and agreed as a condition for financing while Activity 1 (of the technical assistance for barrier removal and institutional strengthening) under the Project is designed to address this issue in more detail for subsequent wind farms. The second lesson is the importance of reliable high-quality wind resource data, which will be addressed under Activity 4. The third lesson is the importance of the market mechanism policies to reduce the costs of wind-based electricity, which will be addressed under Activity 3.

III. FINANCING

A. Budget and Financing Plan

20. No GEF financing under PDF (blocks A, B, and C) has been requested for Project preparation. It is envisaged that GEF will provide a zero-interest contingent loan of $6 million to address the incremental financial risks associated with the construction and operation of the wind farms providing approximately US$2 million of the contingent loan for each wind farm. If the wind farms are successful, it will be repaid to GEF by the 10th year following completion of the wind farms through ADB. If the wind farms are unsuccessful as a result of wind resource and/or technology deficiencies beyond the control of the wind farm operators (see paragraph 17), it reverts to a grant.. The remaining foreign exchange costs of $58 million will be financed by a loan from ADB that will carry a front-end fee of 1 percent, an interest rate to be determined in accordance with ADB's pool-based variable lending rate system for US dollar loans, and a commitment charge of 0.75 percent a year. The loan will have a repayment period of 20 years and a grace period of 3 years. The GEF contingent loan and the ADB loan will be provided under a joint cofinancing arrangement which will result in a net effective interest rate of the combined proceeds of 5.9 percent. The local currency costs associated with the construction of the wind farms will be financed by the Executing Agencies (the provincial power companies) through mobilizing equity participation in the wind farms from their own and other sources and arranging loans from domestic banks and/or financial institutions. The technical assistance for barrier removal and institutional strengthening of $6 million equivalent is envisaged to be financed by GEF on a grant basis. The financing plan for the Project is given below.

Table 2: Financing Plan
($ million)

Item	Foreign Exchange	Local Currency	Total	Percent of Total
Equity				
XEPC (Executing Agency)		7.0	7.0	7.0
HEPC (Executing Agency)		5.8	5.8	6.0
LEPC (Executing Agency)		5.7	5.7	5.7
Total Equity		18.5	18.5	18.7
Loans				
ADB	58.0		58.0	58.7
GEF (contingent loan)	6.0		6.0	6.1
Domestic Banks		10.2	10.2	10.4
Total Loans	64.0	10.2	74.2	75.2
GEF Grant (technical assistance)	4.8	1.2	6.0	6.1
Total Project	**68.8**	**29.9**	**98.7**	**100.0**

B. Incremental Cost

21. The total baseline costs of the Project are $86.7 million. The total Project costs are $98.7 million including total incremental costs of $12 million. The detailed costs are given in the section E of the Project Brief. An incremental cost assessment, including incremental cost matrix, is provided in Appendix 16 of the Project Brief. It discusses the baseline scenario and the GEF alternative scenario and identifies incremental cost components.

C. Financial Modality

22. The use of the contingent loan can be seen as a temporary, evolving, financing tool to be used in the early technology development stage of wind-based electricity generation and in the absence of a separate market for renewable energy when the cost of the capital goods and produced electricity are still relatively high in comparison with conventional power generation and financing for construction of the same on a non-concessionary basis is considered relatively risky in view of the perceived performance risks. The GEF contingent loan for the Project will merely balance the higher risks and costs and associated with developing the initial wind farms in an incipient market that is not at a level playing field with the market for conventional power generation. The contingent loan approach will help reduce the performance risks i.e, the wind resource and technology risks, associated with the operation of the three wind farms, which have high front-end costs. It will make the first time financing of wind farms through a non-concessionary loan from a multilateral development agency less risky and acceptable to the investors/Executing Agencies (the provincial power companies). These efforts will ensure the financial sustainability and viability of the wind power development after Project completion. It will thereby facilitate the investments to be made by the Executing Agencies while ensuring the effectiveness of the associated loans from domestic banks and ADB. The success of the three wind farms will demonstrate the technical and commercial viability of large-scale grid-connected wind farms in the PRC largely financed from non-concessionary sources. It will therefore facilitate the development of future wind power in the PRC, thereby reducing future perceived performance risks.

D. Financial Sustainability

23. The financial sustainability of the GEF-financed wind farms will be ensured through the policy dialogue ADB had with regard to the dispatch and distribution of the electricity. First, the Government has agreed that the purchasers/distributors of the electricity, the provincial power companies, will be fully compensated for the incremental cost of the electricity and second, under the PPAs the provincial power companies will be required to give priority to the dispatch of the electricity. This will substantially increase the use and availability of the wind farms in comparison with other wind farms in the PRC and reduce the tariffs. Also, the O&M capability of wind farm personnel will be strengthened through O&M training by the turbine manufacturers during the first year of operations. The implementation arrangements for construction of the wind farms with separate Project implementation offices for construction of each wind farm assisted by Project implementation consultants will also ensure that the required technical and organizational skills will be available to plan and supervise the construction of the wind farms and operate the same after one year of operation by the contractors.

IV. INSTITUTIONAL COORDINATION AND SUPPORT

A. Core Commitments and Linkages

24. The ADB's Country Assistance Plan for the PRC is aimed at helping the country achieve economic growth in an efficient, equitable, and sustainable manner. In the power sector ADB is placing priority on the need to meet the growth in power demand, and enhance energy efficiency and reduce adverse environmental impacts. In this context ADB promotes the development of cleaner energy sources including renewable energy. ADB has provided grants with an estimated total value of more than $6 million for a number of technical assistance projects to promote renewable energy development and reduce GHG emissions in the PRC. The Project will be the first ADB-financed project for renewable energy development in the PRC and has been developed following a detailed feasibility study financed and implemented by ADB.

B. Consultation and Coordination

25. During the Project's design close consultations were held with the relevant Government agencies, UNDP, and the World Bank to coordinate the proposed activities under the Project with their ongoing and planned activities to promote renewable energy development in the PRC. Complementarity of the bottom-up approach of the Project activities in the three provinces with the activities envisaged under the future GEF/World Bank input for the Government's Strategic Partnership for Renewable Energy Development has been assured through the design of specific activities at the level of the three concerned provinces where until now no barrier removal activities have taken place and coordination of these activities by SDPC which is also the National Coordinating Agency for the Government's Partnership for Renewable Energy Development. During Project implementation, coordination of activities will be facilitated through the sharing of the findings and reports as well as regular meetings of ADB staff with UNDP and World Bank counterparts to discuss the same.

V. RESPONSIVENES TO REVIEWS

A. Comments on the Concept Paper

26. The GEF Council has made no comments on the Concept Paper upon pipeline entry. Comments made by the GEF Secretariat concerned (i) the confirmation of country drivenness and conformity with the current renewable energy priorities of the Government, (ii) the need for clarification on how the Project relates to ongoing renewable energy efforts in the PRC and how it will be coordinated, (iii) the need for clarification how the Project relates to currently ongoing efforts to develop a strategic renewable energy market development framework, and (iv) the need for one lead agency to be designated by the Government for the development of the programmatic renewable energy framework which would avail of PDF funding. Issue (i) has been addressed in paragraphs 2-8 above. With regard to issues (ii) and (iii) it has explained in the previous paragraph that the Project has been developed at the provincial level and will operate within the framework envisaged to be developed under the Government's Partnership for Renewable Energy Development. ADB is also expected to contribute further to this partnership which will facilitate coordination of the activities under the partnership with activities under the Project and ADB consultations with all other parties contributing to the partnership. The Government considers the Project to be part of this partnership. With regard to issue (iv) the Government has decided that SDPC, the National Coordinating Agency for the Project, will be the lead agency for the development of the programmatic renewable energy framework (under the partnership). The World Bank's comments on the Concept Paper mainly concerned the overlap of activities that at the time of preparation of the Concept Paper were envisaged for GEF financing under the Project. However, the presently envisaged activities as listed in paragraph 10 do not overlap with any other ongoing or envisaged activity and will complement or strengthen ongoing activities such the establishment of a national wind resource database and promotion of private sector investments in wind farms.

B. Comments on the Project Brief

27. GEFSec commended the cover note as an excellent note that may serve as a role model for future submissions of cover notes by Implementing Agencies. GEFSec recommended the Project for work program inclusion as an intervention that meets OP#6 programming criteria and supports the objectives of the GEF renewable energy partnership with the PRC. In addition, it was agreed with GEFSec that to avoid misunderstandings on the nature of the contingent financing and the risks covered, a section would be added to the Project Brief, which underlines that the proposed financing modality does by no means constitute a capital cost subsidy. This is explained in the attached Project Brief (paragraphs 67 and 68) and can be summarized as follows:

(i) The use of the GEF contingent loan is an innovative tool that will be provided to share with the wind farm companies the perceived performance risks associated with wind farms in the PRC and build confidence in the new technology. As explained in paragraph, item (vii) above, these performance risks comprise the wind resource risk and the technology risk as experienced by wind farm developers in the PRC. It can reasonably be expected only that these perceived risks will gradually decrease over time with leveling of the playing field for wind power vis-à-vis conventional power, increased construction of wind farms, and

increasing experience in wind farm development and operations.

(ii) In this context, the use of the GEF contingent loan should be seen as a financing mechanism that is temporarily used for merely balancing the higher performance risks associated with developing wind farms in an incipient market that is not at a level playing field with the market for conventional power generation and from a financial perspective is not competitive with it.

(iii) The GEF contingent loan will provide the necessary encouragement to the Executing Agencies to invest in the development of wind farms prior to the establishment of a separate market for renewable energy that is expected to become gradually operational during the Government's TFYP only. In the meantime, use of the GEF contingent loan will thus help create a momentum for accelerated development of large-scale wind farms and will contribute to improved conditions for development of such wind farms once the separate market for renewable energy has become operational. Any hiatus in the establishment of new large scale wind farms until then will result in considerable opportunity costs in terms of a continuing stagnant market, delayed localizing of assembly/manufacturing of wind turbines, deferred gains in experience in operating large scale wind farms, postponement of mobilizing nongovernment funds for financing large scale wind farms, and delays in adopting appropriate policies and creating the necessary conditions for further wind power development in the three provinces.

(iv) As stated in paragraph 19, the effective interest rate of the combined GEF contingent loan and the ADB loan is 5.9 percent which is close to the estimated weighted cost of capital for the Executing Agencies at 6.0 percent and the present interest rate on local borrowings; any grant element in this financing arrangement is therefore expected to be marginal.

28. ADB will also address the following conditions set by GEFSec for GEF CEO endorsement:

(i) The Project Brief to be submitted for endorsement should provide a specific section that
explains how the intervention contributes to the implementation of the Government's renewable energy partnership, and how it follows the partnership framework to be presented by the Government later this year.

(ii) Risks that will be addressed by proposed contingent financing modalities, risk sharing
arrangements, and related repayment and time frames need to be spelled out explicitly.

(iii) Performance indicators and monitoring arrangements required to guide the repayment of the contingent loan should become part and parcel of a comprehensive M&E plan, which would also explain how the lessons learned in the investments sponsored by the Project would be disseminated and utilized to promote replication.

B. Other Technical Comments

29. As requested by the Government ADB is expecting to become more involved in the development and financing of renewable energy projects in the PRC in the coming years. It is taking steps to develop a pipeline of suitable projects and is expected to increase the number of staff assigned to renewable energy activities.

C. STAP Roster Review

30. An independent technical (STAP) review of the Project was carried out by D. Kammen of the University of California, Berkeley. The STAP review and ADB's response are attached in Appendix 17 of the Project Brief.

1 August 2000

RRP:PRC 31163

PROJECT BRIEF

ASIAN DEVELOPMENT BANK

REPORT AND RECOMMENDATION

OF THE

PRESIDENT

TO THE

BOARD OF DIRECTORS

ON A

PROPOSED LOAN

AND TECHNICAL ASSISTANCE GRANT

TO THE

PEOPLE'S REPUBLIC OF CHINA

FOR THE

WIND POWER DEVELOPMENT PROJECT

August 2000

CURRENCY EQUIVALENTS

(as of 1 August 2000)

Currency Unit	—	Yuan (Y)
Y1.00	=	$0.1208
$1.00	=	Y8.2779

The exchange rate of the yuan is determined in relation to a weighted basket of currencies of the trading partners of the People's Republic of China. In this report, a rate of $1.00 = Y8.30 has been used.

ABBREVIATIONS

ADB	–	Asian Development Bank
CH_4	–	methane
CO_2	–	carbon dioxide
DMC	–	developing member country
EIA	–	environmental impact assessment
EIRR	–	economic internal rate of return
EMDP	–	Ethnic Minorities Development Plan
FIRR	–	financial internal rate of return
GDP	–	gross domestic product
GEF	–	Global Environment Facility
GHG	–	greenhouse gas
HEPC	–	Heilongjiang Electric Power Company Ltd.
IA	–	Implementing Agency
ICB	–	international competitive bidding
IEE	–	initial environmental examination
IS	–	international shopping
JFPR	–	Japan Fund for Poverty Reduction
LEPC	–	Liaoning Electric Power Company Ltd.
LNG	–	liquefied natural gas
MBI	–	market-based instrument
MEP	–	Ministry of Electric Power
MOST	–	Ministry of Science and Technology
NFFO	–	non-fossil fuel obligation
NFYP	–	ninth five-year plan
NO_x	–	nitrogen oxides
PIO	–	project implementation office
PMO	–	project management office
PPA	–	power purchase agreement
PPC	–	provincial power company
PRC	–	People's Republic of China
PV	–	photovoltaic
RPS	–	renewable portfolio standard
SDPC	–	State Development and Planning Commission
SEPA	–	State Environmental Protection Administration

SETC	–	State Economic and Trade Commission
SIEE	–	summary initial environmental examination
SP	–	State Power Corporation
SOE	–	state-owned enterprise
SO_2	–	sulfur dioxide
TA	–	technical assistance
TFYP	–	tenth five-year plan
TSP	–	total suspended particulates
UNDP	–	United Nations Development Programme
WFC	–	wind farm company
WHO	–	World Health Organization
XEPC	–	Xinjiang Electric Power Company Ltd.

WEIGHTS AND MEASURES

GW	–	gigawatt (one billion watts)
km	–	kilometer
kV	–	kilovolt (1,000 volts)
kW	–	kilowatt (1,000 watts)
kWh	–	kilowatt-hour (power supply of 1,000 watts in one hour)
m^2	–	square meter
m^3	–	cubic meter
mg	–	milligram
µg	–	microgram
MVA	–	megavolt-ampere
MW	–	megawatt (1,000,000 watts)
TWh	–	terawatt-hour (power supply of one trillion watts in one hour)

NOTES

(i) The fiscal year (FY) of the Government and the executing and implementing agencies coincides with the calendar year.

(ii) In this report, "$" refers to US dollars and tons refer to metric tons.

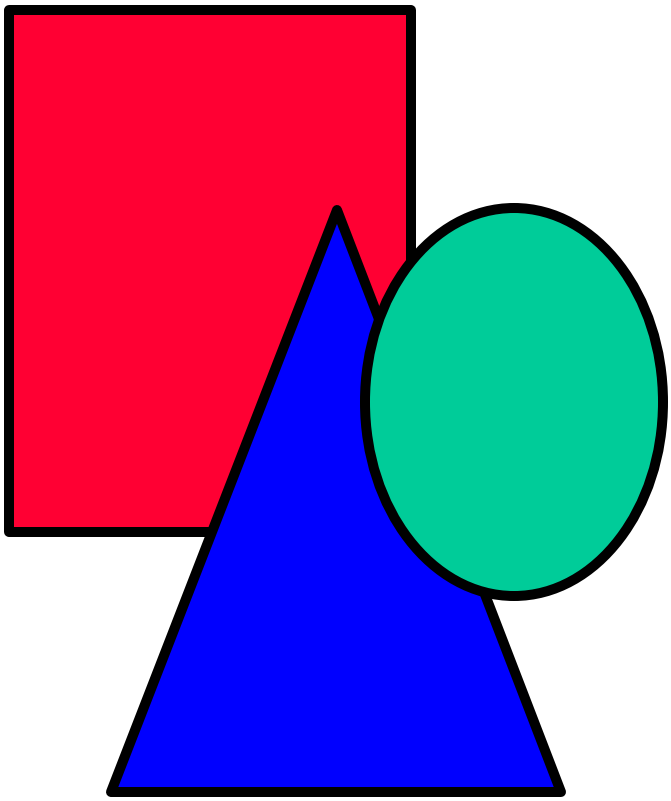
CONTENTS

LOAN AND PROJECT SUMMARY

Borrower	:	The People's Republic of China (PRC)
Project Description	:	The Project will help to develop the PRC's renewable energy resources by financing the construction of three wind farms with a total power generation capacity of 78 megawatts (MW). With support from the Global Environment Facility (GEF), the Project will also provide assistance for removal of impediments and strengthening of institutions (Barrier Removal and Institutional Strengthening) to promote further development of wind-based power generation in the three provinces.
Classification	:	Primary: Environment
Environmental Assessment	:	Category B: An initial environmental examination was undertaken.
Rationale	:	The PRC's heavy reliance on coal as its primary fuel for power generation as well as industrial, commercial, and residential use has led to high levels of air pollution, resulting in adverse health impacts and agricultural losses. The Project is designed to produce electricity in an environment-friendly manner. The Project will help accelerate the use of wind power in the PRC and thereby contribute to the 5 percent share of renewable energy sources in the power generation mix as envisaged by the Government under its tenth five-year plan 2001-2006, improving conditions for investment in wind-based power plants. The Project will also benefit the poor in the three provinces through job creation, cleaner air, and better electricity supply. The Project is consistent with ADB's strategy to develop cleaner energy sources such as renewable energy for power generation.
Objective and Scope	:	The objective of the Project is to produce electricity in an environment-friendly manner by developing wind-based power generation and thereby avoid emissions of sulfur dioxide, nitrogen oxides, total suspended particulates, and carbon dioxide associated with conventional thermal power generation. The scope of the Project comprises (i) construction of wind farms at Dabancheng in the Xinjiang Autonomous Region (30 MW); at Fujin in Heilongjiang Province (24 MW); and at Xiwaizi in Liaoning Province (24 MW); and (ii) technical assistance for Barrier Removal and Institutional Strengthening to promote wind-based power generation in the three provinces.
Cost Estimates	:	The total project cost is estimated at $98.7 million equivalent, comprising a foreign exchange cost of $68.8 million (70 percent) and a local currency cost of $29.9 million equivalent (30 percent).

Financing Plan	:	ADB will provide a $58.0 million loan and GEF a contingent grant of $6.0 million (a zero-interest loan which is repayable after ten years) to finance the foreign exchange cost of the construction of the wind farms. GEF will also provide a grant of $6.0 million for Barrier Removal and Institutional Strengthening in the three provinces to promote renewable energy development and utilization. The remaining local currency cost of $28.7 million equivalent will be financed by the Executing Agencies and domestic banks.
Loan Amount and Terms	:	ADB's $58 million loan from its ordinary capital resources will have a repayment period of 20 years, including a grace period of 3 years, with interest determined in accordance with ADB's variable lending rate system for US dollar loans, a front-end fee of 1 percent, and a commitment charge of 0.75 percent per annum in accordance with the current ADB policy. The GEF contingent grant of $6 million will be blended with the ADB loan under a joint cofinancing arrangement to finance the foreign exchange costs of the construction of the wind farms. The combined proceeds will be relent by the Ministry of Finance (MOF) to the Executing Agencies through subsidiary loan agreements under the same terms and conditions. The Executing Agencies in turn will onlend the loan proceeds under the same terms and conditions to the wind farm companies (WFCs) to be established for each wind farm
Period of Utilization	:	Until 31 December 2003.
Executing Agencies	:	The respective provincial power companies (PPCs) will be the Executing Agencies for the Project (i.e., the Xinjiang Electric Power Company Ltd. for the wind farm at Dabancheng; the Heilongjiang Electric Power Company Ltd. for the wind farm at Fujin; and the Liaoning Electric Power Company Ltd. for the wind farm at Xiwaizi). The Executing Agency for the Barrier Removal and Institutional Strengthening will be the State Development and Planning Commission (SDPC) in cooperation with the State Power Corporation (SP).
Implementation Arrangements	:	The respective Executing Agencies will be responsible for procurement, preparation of legal agreements, and disbursement of funds. The WFCs will act as Implementing Agencies and will be responsible for site preparation, construction supervision, and liaison with the concerned Executing Agency. SDPC will coordinate implementation of the technical assistance for Barrier Removal and Institutional Strengthening with the concerned provincial planning commissions and stakeholders.
Procurement	:	The equipment, materials, and services financed from the proceeds of the ADB loan and ADB arranged cofinancing from GEF will be procured in accordance with ADB's *Guidelines for Procurement*. Items financed with local currency funds by the

		Executing Agencies will be procured following Government procurement procedures acceptable to ADB.
Consulting Services	:	International consulting services for 30 person-months will be engaged for the wind farms to assist (i) the Executing Agencies with the preparation of the necessary documents for procurement and supply of the wind turbines and towers on a engineering, procurement, and construction (EPC) basis, and (ii) the Implementing Agencies with supervising construction, installation, and commissioning of the wind farms. Domestic consulting services of about 200 person-months and international consulting services of about 100 person-months will be engaged for Barrier Removal and Institutional Strengthening. All consultants financed by the ADB loan and GEF will be engaged in accordance with ADB's *Guidelines on the Use of Consultants*.
Estimated Project Completion Date	:	30 June 2003
Project Benefits and Beneficiaries	:	The Project will produce electricity in an environment-friendly manner and thereby avoid air pollution. Over its lifetime, it will help avoid emissions of about 11,000 tons of sulfur dioxide, 7,400 tons of nitrogen oxides, 5,000 tons of particulates and 1.94 million tons of carbon dioxide. It will also accelerate the use of wind-based electricity in the PRC. The Project will also benefit the poor. It will create a minimum of 390 job-years for the operation and maintenance of the wind farms. A cleaner atmosphere will improve health and quality of life. To provide more benefits to the poor, specific poverty reduction activities will be undertaken in association with the Project with support from the Japan Fund for Poverty Reduction. Both the financial and economic internal rates of are satisfactory for the three wind farms. The former range from 7.6 percent to 8.3 percent, and the latter range from 12.7 percent to 16.0 percent.



I. THE PROPOSAL

1. I submit for your approval the following Report and Recommendation on (i) a proposed loan to the People's Republic of China (PRC) for the Wind Power Development Project (the Project); (ii) proposed administration by ADB of a contingent grant from the Global Environment Facility (GEF) for the Project; and (iii) proposed administration by ADB of technical assistance (TA) to be financed from GEF for Barrier Removal and Institutional Strengthening to promote wind power development.

II. INTRODUCTION

2. The PRC is the third largest energy user in the world after the United States and Japan. Coal is the dominant primary source of energy accounting for 72.0 percent of total commercial energy production in 1998, followed by oil (18.5 percent), hydropower (7.1 percent), and natural gas (2.4 percent). The continued dominance of coal in the energy mix has major environmental repercussions, including unacceptably high levels of air pollution which have lead to health problems and increasing mortality rates, degenerating ecosystems, decreasing crop yields, and increasing emissions of greenhouse gasses (GHGs) and occurrences of acid rain. The Government has recognized the need to address the environmental problems associated with the energy sector, and has reiterated its commitment to increased use of renewable energy as outlined in its Program on New and Renewable Energy Development in the PRC (1996-2010). Under the program, the Government gives priority to the development of grid-connected wind-based electricity generation (wind farms) to (i) diversify the power supply, (ii) develop sustainable renewable energy resources, and (iii) derive environmental benefits, in particular, by reducing air pollution.

3. In 1997, the Government requested assistance from the Asian Development Bank (ADB) for wind farms in the Xinjiang Autonomous Region and in Heilongjiang and Liaoning provinces with a total power generation capacity of about 100 megawatts (MW). In response to this request, in September 1998, ADB provided project preparatory TA to examine the feasibility of establishing such wind farms.[1] Following completion of the project-preparation studies in January 2000, an ADB Fact-finding Mission[2] visited the PRC in March 2000 to discuss the proposed Project with the Government and the Executing Agencies and Implementing Agencies (IAs). The linkages among the policies, institutional framework, physical investments and objectives of the Project are described in the Project Framework (Appendix 1). The Project's primary objective is environment.

III. BACKGROUND

A. Status of Renewable Energy

4. The PRC's renewable energy resources comprise small-scale hydropower (plants with a capacity of up to 25 MW), wind, biomass, and solar and geothermal energy. About 90 percent of rural households are already connected to distribution networks. However, electricity tariffs for

[1] TA 3071-PRC: *Wind Power Development Project*, for $600,000, approved on 21 September 1998.

[2] The Mission was composed of E. Hassing, Senior Project Officer/Mission Leader; J. Ordona, Senior Financial Analyst; P. Abeygunawardena, Senior Economist for Environment; M. Nagata, Sr. Programs Officer; B. Q. Lin, Economist; S. Tamandong, Poverty Reduction Coordinator, and I. Simbolon, Social Development Specialist.

rural households are relatively high (on average 1.5 to 2 times higher than urban household tariffs).

5. At present, renewable energy resources used for power mainly consist of small-scale hydropower and account for about 5 percent of the total electricity generated. To maintain this share of renewable energy in the power supply mix over the next ten years, about 18 gigawatt (GW) of installed capacity would need to be added. Small-scale hydropower has been developed to commercial levels for decentralized rural use and totals about 18 GW. The total installed capacity of solar photovoltaic (PV) energy is about 30 MW, with the Government targeting the installation of an additional 15 MW over the next five years. Geothermal energy, with an installed generating capacity of 28 MW, plays a minor role in energy supply.

6. The economically usable wind resource potential in the PRC is estimated as high as 160 GW. However, wind-based power generation, while increasing, is still very limited with a total installed capacity of about 265 megawatts (MW),[3] or only about 3 percent of the renewable energy produced in the PRC. This reflects the absence of appropriate policies that would promote development of renewable energy, and wind-based power generation in particular. Foremost, the Government does not require that a certain percentage of the electricity generated is produced from renewable energy sources, unlike some other ADB member countries that are promoting the development of separate markets for renewable energy.[4] Such separate markets are necessary since in the PRC the costs of electricity generated from renewable energy sources are usually higher than electricity generated in conventional thermal power plants, which use relatively inexpensive coal. Also, the coal and thermal power pricing regimes do not internalize the environmental costs associated with air pollution. As a result, there are no financial incentives to invest in renewable energy. Biomass, i.e., fuelwood and crop residues, accounts for nearly a quarter of the country's energy supply. In rural households, biomass accounts for about three quarters of energy consumption. As a result, deforestation problems are prevalent in some areas and have contributed to soil erosion and floods. The Government has taken measures to address this problem by encouraging more efficient use of fuelwood, improving natural resource management, promoting afforestation, and providing rural households with access to electricity.

7. ADB provided an advisory TA in 1994 to help accelerate the pace of rural energy development based on renewable energy.[5] The TA was built on the concept that identifying rural energy supply options in pilot areas, coupled with the training of Ministry of Agriculture staff, would accelerate rural energy development. The TA also evaluated the economic and financial viability for possible ADB financing of (i) large-scale biogas systems, (ii) solar water heaters, and (iii) biomass cogeneration. However, at that time, the Government was reluctant to consider borrowing from ADB's ordinary capital resources for renewable energy projects unless such borrowing could be blended with concessionary financing. Another TA has been provided to the Ministry of Agriculture to prepare a project for efficient utilization of agricultural waste products to improve the physical environment and reduce poverty.[6] Finally, TA to the Government is under way for (i) enhancing the institutional framework for providing consumer-oriented

[3] The Government's original target to have 1,000 MW of grid-connected wind farms operational by 2000 will not be met.

[4] Suitable mechanisms for creating such markets with due consideration for efficiency include (i) following a bidding process for purchase by utilities of a fixed amount of electricity from renewable sources (i.e., the so-called non-fossil fuel obligation (NFFO), used in the United Kingdom); and (ii) establishing a renewable portfolio standard (RPS) that requires that a certain percentage of electricity generated be produced from renewable energy sources (used in Denmark, the Netherlands and certain parts of the United States).

[5] TA 2100-PRC: *Rural Energy Development Study*, for $500,000, approved on 16 June 1994.

[6] TA 3370-PRC: *Efficient Utilization of Agricultural Wastes*, for $703,000, approved on 26 December 1999.

financing with technical service support, (ii) developing and evaluating prioritized investment programs for commercialization of selected renewable energy technologies, and (iii) identifying specific investment requirements for external financing.[7] In addition to ADB, the World Bank/GEF and the United Nations Development Programme (UNDP)/GEF, have begun selective programs in this area (para. 32). The Government, under its recently announced strategy for development of the western regions of the PRC, will promote the use of renewable energy for supplying off-grid electricity to rural communities.

B. Energy Sector

1. Overview

8. Annual per capita energy consumption in the PRC is low at 1.1 tons of oil equivalent (about 40 percent of the world average). However, energy intensity in 1998 at 1.7 tons of oil equivalent per thousand 1998 dollars of gross domestic product (GDP) was almost double the average for ADB's developing member countries (DMCs). From 1990 to 1998, the average annual real GDP growth rate was 9.6 percent, while energy consumption grew at 4.4 percent. Therefore, the energy intensity index[8] declined from 62.6 in 1990 to 37.9 in 1998 (Appendix 2). This decline reflects changes in economic structure and sources of industrial value added (75-85 percent), as well as energy efficiency improvements (15-25 percent). However, the energy intensity in the PRC is still relatively high and more than twice the average energy intensity for industrialized countries. The PRC's high energy use and intensity are mainly attributable to (i) the legacy of a past inappropriate pricing regime with inadequate market-based signals for energy conservation; (ii) an energy-intensive industrial sector that accounts for a relatively high share of GDP; (iii) a poor fuel consumption mix; (iv) the use of obsolete industrial technologies; (v) poor energy management; and (vi) a relatively lower GDP base, as compared with developed countries, which overemphasizes energy use per unit of GDP.

9. The PRC is the second largest electricity producer in the world. Between 1980 and 1998, installed capacity and annual electricity generation grew at average annual rates of about 8.3 percent and 7.8 percent, respectively, reaching 277 GW and 1,158 terawatt-hours (TWh) (Appendix 3). Every year since 1988, 11-15 GW of generating capacity had been added to remove the acute shortages in generating capacity.[9] Starting in 1997, the macroeconomic and industrial sector changes, coupled with the indirect effects of the Asian financial crisis, tempered in the growth of electricity consumption. An installed capacity of 290 GW (comprising 220 GW of thermal power plants and 70 GW of hydropower) providing annual electricity generation of about 1,400 TWh (comprising 1,120 TWh of thermal power plants and 280 TWh of hydropower) is envisaged by the end of the ninth five-year plan (NFYP) in the year 2000.

10. In 1998, 76 percent of the total installed capacity of 277 GW used fossil fuels, 23 percent hydropower, and 1 percent was nuclear-based. The 1998 per capita annual electricity consumption of 909 kilowatt-hours (kWh) places the PRC at the mid-level among ADB's DMCs.[10] Most of the electricity is consumed by industries (Appendix 3). Heavy industry had a share of 58 percent in 1998, followed by light industry (14 percent), residential consumers (12 percent), public and commercial consumers (8 percent), agriculture (6 percent), and transportation and telecommunications (2 percent). The relative shares of industry and

[7] TA 3056–PRC: *Renewable Energy Development Project*, for $600,000, approved on 25 August 1998.
[8] Expressed as unit of energy consumed per unit of GDP in 1978 constant prices, with the index set at 100 for 1978.
[9] This is equivalent to adding the existing installed capacity of countries such as Belgium, Netherlands or Finland in one year.
[10] Malaysia - 1,636 kilowatt-hours (kWh), Thailand - 1,023 kWh, Philippines - 419 kWh, India - 325 kWh, and Sri Lanka - 224 kWh.

agriculture have been declining, while those of residential, public, and commercial consumers have been increasing since 1985. About 98 percent of the nation's villages and 97 percent of the rural population have access to electricity, although service is of uneven quality.

2. Pricing

11. Electricity tariffs are set separately in each province. Tariff proposals are prepared jointly by the provincial power companies and the provincial governments (mainly the provincial price administration bureaus) and submitted to the Government for approval by the State Development and Planning Commission (SDPC). Tariffs generally have three components: (i) state catalog price, (ii) guidance price differential, and (iii) surcharges. The state catalog price is calculated to recover costs financed through Government grants (all plants built before 1985) and, in some cases, loans from the Government for plants built after 1985. Electricity from power plants financed by joint investment from central, provincial, and local governments, plants of independent power producers, and plants owned by local governments or industries that sell surplus power to the grid, is sold at a guidance price which is based on full cost recovery including debt repayment and a reasonable return on investment. Several surcharges are levied on the various consumer categories, primarily for different types of investment funds for the power sector. The most important levies are: (i) the provincial and local government power investment surcharges, which raise funds for special projects (e.g., the Three Gorges project); and (ii) local fees to raise funds for distribution system investment. Surcharges usually account for 13 to 15 percent of the average tariff.

12. Before 1985, electricity tariffs in the PRC remained at a low level for many years, averaging about Y0.07 per kWh. Starting in 1985, the tariffs were increased in response to price increases in capital, fuel and other operating costs. However, the tariff adjustments had several shortcomings, as a result of which tariff systems were complicated and unfair to different consumer categories and similar consumers in different localities. The Government regards tariff reform as a prerequisite for the development of the power industry. Unification of tariffs to ensure charging, on a cost recovery basis, the same price for the same quality of electricity to a given class of consumer in a particular grid, is an important objective.

13. The Government is using a combination of administrative controls and market-based instruments (MBIs) to improve end-use energy efficiency. The administrative measures include reductions in planned allocations of energy to major industrial users, tightening energy consumption norms, stricter application of such norms with bonuses and penalties, and closing of inefficient plants. The Government gives increasing priority to MBIs, including price reforms, and is aiming to achieve further gains in end-use energy efficiency through implementing structural adjustments in the industrial sector, promoting the upgrading of technology, and strengthening energy management.

3. Environment

14. The PRC has severe environmental problems, primarily air and water pollution associated with the rapid economic growth and industrialization. Estimates of economic losses caused by pollution range from 3.5 percent to 8.3 percent of GDP. Based on a recent study by the Policy Research Center for Environment and Economy of the State Environmental Protection Administration (SEPA), pollution in the early 1990s caused annual economic losses of Y99 billion (about 4 percent of GDP), with air pollution accounting for 59 percent, water pollution for 36 percent, and solid waste for 5 percent. Much of these losses were due to energy sector or related activities.

15. The high economic losses reflect waste and inefficiency in the utilization of energy, raw materials, and other resources in the production of goods and services. This is partly a legacy of the past practice of locating industrial enterprises in urban centers, and inappropriate regulatory measures and pricing policies that did not provide adequate incentives for conservation and environment-friendly behavior. Depending on the industry, 30-70 percent of industrial pollution is linked to waste and inefficiency resulting from the use of obsolete technology, inadequate knowledge of available cleaner technology, low level of environmental awareness, and poor enterprise management. Use of energy and raw materials will continue to grow in the PRC in tandem with economic growth. Unless better technologies are used, switching to cleaner fuels is encouraged, and use of renewable energy is increased in a major way, environmental quality will further deteriorate and the related economic losses will increase.

16. The PRC's heavy reliance on coal as its primary fuel for industrial production, power generation, and commercial and residential applications, mainly cooking and heating, contributes significantly to emissions of sulfur dioxide (SO_2), and total suspended particulates (TSP), and the high levels of urban air pollution. Nine of the ten cities with the worst air pollution in Asia and five of the ten worst in the world are in the PRC. Air quality is poor in all of the PRC's industrial cities. Airborne concentrations of TSP and SO_2 often substantially surpass environmental standards.[11] The social cost of this pollution is high. Over 400 million people live in cities and the number is expected to double by the year 2010. Annual premature deaths related to excessively high TSP concentrations are currently estimated at 150,000 in urban areas. Chronic pulmonary diseases linked to exposure to TSP are a leading cause of death among urban residents, accounting for 0.91 death per 1,000 people, five times more than that in the United States. The combustion of coal in small boilers, mainly for commercial and residential use, is responsible for a significant portion of total air pollution. To combat air pollution from such sources the Government gives priority to: (i) developing district heating systems that will replace individual coal combustion for residential heating; (ii) developing gas supply networks that will replace coal combustion with a cleaner form of energy for household cooking and, in some instances, heating; and (iii) introducing clean coal technologies and other environment friendly technologies for power generation. Also, the introduction of advanced clean coal technologies such as pressurized fluidized bed combustion and integrated coal gasification combined cycle technology is being considered.[12] In April 2000, the Law on the Prevention of Air Pollution was adopted, which will enable the Government to take effective measures to encourage and support scientific research and technology development for the prevention and control of air pollution.[13]

4. Pollution Permits and Green Credits

17. The PRC has adopted several programs to guide the development of the economy and protect the environment. Its Agenda 21 Program, developed in response to the 1992 Earth

[11] The concentration of TSP in residential areas increased from 276 micrograms (μg) per cubic meter (m^3) in 1986 to about 309 $\mu g/m^3$ in 1996, three to five times higher than the guidelines of the World Health Organization (WHO) of 60-90 $\mu g/m^3$. The concentration of SO_2 in these areas increased from 70 $\mu g/m^3$ to 120 $\mu g/m^3$, more than double the WHO standard of 40-60 $\mu g/m^3$. By 1997, in almost all major cities emissions of nitrogen oxides (NO_x) exceeded the Government standard for urban areas of not more than 50 $\mu g/m^3$.

[12] Under TA 2793-PRC: *A Study on Clean Coal Integrated Gasification Combined Cycle Technology*, for $500,000, approved on 19 May 1997, ADB helped assess suitable technologies.

[13] The law provides a legal basis for the adoption of the total load control strategy to reduce air pollution. It specifies the key pollutants for total load control (including SO_2), and establishes principles for total load allocation among polluting sources and air emission permits. However, it does not identify a mechanism for the transfer and trade of the permits. A new provision (Provision 9) addresses clean energy; it specifies that "the state encourages and supports the exploitation of clean energy such as solar, wind and hydrological power."

Summit, is designed to integrate economic and social development by improving the efficiency of energy utilization, introducing environment-friendly technologies, and managing toxic and hazardous wastes. The Government is beginning to respond to global environmental problems such as climate change. With ADB assistance, it has developed methodologies for evaluating GHG emissions and outlined options for policy implementation.[14] Coalbed methane gas released in connection with coal mining is one of the major sources of GHGs in the PRC, and ADB is providing assistance to evaluate possible options for more efficient capture and use of the gas.[15] Acid rain issues have been analyzed to establish the necessary database and undertake institution-building activities. Strategies to minimize SO_2 emissions that cause acid rain have been formulated and are under implementation.[16] The Government has also participated in ADB's regional activities relating to global warming and transboundary environmental cooperation in northeast Asia,[17] identified 18 GHG abatement technology options, and prepared a portfolio of 2 TA and 7 investment projects for GHG abatement, largely in the energy supply and demand sectors.

18. Pollution permit trading is an emerging MBI that is receiving increasing attention for air quality management in the PRC. It provides opportunities for polluters to buy or sell the permits for air emissions and effluent discharges to achieve compliance with environmental standards and meet legal and regulatory requirements. Polluters with high marginal abatement costs may buy rights from other firms with lower abatement costs, resulting in a cost-effective way of reaching environmental targets. Conversely, firms with low marginal pollution abatement costs will find opportunities to control pollution discharges below permitted amounts and sell the excess rights to polluters with higher costs. Compared with the traditional command-and-control approaches, MBIs including emission permit trading improve the efficiency of pollution control and provide incentives to improve the environment.[18] In Shanxi Province, ADB is providing TA to facilitate the introduction of MBIs and develop a pollution permit trading system.[19]

19. In addition to limiting pollution through trading of pollution permits, the PRC also has considerable potential for trading of green credits in both the domestic and international markets. Under this credit system, green credits are issued for energy produced from renewable energy sources in an environment-friendly manner. The energy itself is traded and consumed locally while the environmental surplus value (green credits) is reflected in certificates, which are issued by internationally recognized agencies. The issuance of the certificates allows the environmental benefits associated with a certain production of energy to be traded separately from the physical energy. These certificates can be traded locally or internationally thereby promoting development of renewable energy at the most productive and economic sites. The certificates also ensure that consumers have received the amount of green electricity from a particular supplier as reflected in their billing. It is expected that the PRC will begin implementing systems for trading of pollution permits and green credits under its tenth five-year plan (TFYP).

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[14] TA 1690-PRC: *National Response Strategy for Global Climate Change*, for $600,000, approved on 10 April 1992.

[15] TA 3081-PRC: *Coalbed Methane Demonstration Project*, for $600,000, approved on 1 October 1998.

[16] TA 5528-REG: *Acid Rain and Emission Reduction in Asia*, for $450,000, approved on 16 April 1993; and TA 5792-REG: *Acid Rain and Emission Reduction for Asia, Phase II*, for $600,000, approved on 3 September 1996.

[17] TA 5592-REG: *A Study of a Least-Cost Greenhouse Gas Abatement Strategy for Asia*, for $8,237,000, approved on 4 August 1994; with supplementary TAs for $492,000, approved on 10 September 1996, and for $133,363, approved on 19 June 1998; TA 5695-REG: *Environmental Cooperation in Northeast Asia*, for $495,000, approved on 1 August 1996; and TA 5865-REG: *Transboundary Environmental Cooperation in Northeast Asia*, for $350,000, approved on 13 October 1999.

[18] ADB. September 1999. *Emissions Trading in the Energy Sector: Opportunities for the People's Republic of China.*

[19] TA 3325-PRC: *Shanxi Air Quality Improvement*, for $700,000, approved on 7 December 1999.

Internationally, the PRC has considerable potential for such trading as part of global efforts to reduce GHG emissions under the Clean Development Mechanism and the Kyoto Protocol.[20]

C. Institutions and Legal Framework

20. During the past decade, the Government reorganized the energy sector. The objective was to improve governance by separating regulatory and operating responsibilities, and then corporatize the operating entities and use market forces to improve efficiency and promote energy conservation. First, the Ministry of Energy was disbanded and replaced with the Ministry of Electric Power (MEP), the Ministry of Coal Industry, and two corporations looking after petroleum and natural gas. Subsequent administrative reforms aimed at improving the operational efficiency of the power industry led to a further restructuring of MEP with the establishment of the State Power Corporation (SP) in January 1997. In March 1998, MEP was abolished and SP was designated as the agency responsible for power sector enterprise functions.[21] The sector's regulatory and policy functions are the responsibility of the State Economic and Trade Commission (SETC), which also has similar responsibility for the petroleum and coal sectors as well as the country's energy conservation program. Until the mid-1990s, the power sector was governed by laws, administrative rules and regulations, and policy circulars, which were not well coordinated. To address this problem, the Electric Power Law was approved in December 1995 and became effective in April 1996. The law was a major step in making the legal and regulatory framework for the sector more transparent.[22]

21. Under the PRC's State Council, four national agencies are actively involved in development of renewable energy in the PRC: SDPC; SETC; the Ministry of Science and Technology (MOST); and SEPA.[23] SDPC is responsible for evaluation and approval of large renewable energy projects while SETC is responsible for developing industries that can manufacture equipment required for utilization of renewable energy. MOST is responsible for carrying out research and development activities with regard to renewable energy utilization as well as technology transfer, including acquisition of foreign technology. SEPA is involved in renewable energy development programs to protect the local and global environments and assists the Ministry of Finance as the PRC focal point for GEF issues. SDPC, SETC, and MOST have representative offices in each province which report both to the respective agencies and the provincial governments; each agency has also an associated research institute for renewable energy development.

D. Government Plans and Policies

1. Poverty Reduction Strategy

22. The Government has been making major efforts to reduce the imbalance in economic development between the increasingly prosperous coastal provinces and the poorer central and western regions. In the PRC, poverty has traditionally been a rural phenomenon. By pursuing a strategy to raise living standards and incomes in the poorer rural areas through Government

[20] Assistance for such implementation is provided under TA 5861-REG: *Capacity Building for Implementation of the Kyoto Protocol and the Clean Development Mechanism* , for $200,000, approved on 1 September 1999.

[21] At the same time, the Ministry of Coal Industry was abolished and the State Administration of Coal Industry was made responsible for supervision of the coal sector.

[22] The Company Law of 1994 covers the legal status, rights and obligations of the power groups and companies, and promotes the use of solar, wind, geothermal and biomass energy for power generation.

[23] In April 1998, the State Planning Commission became SDPC, the State science and Technology Commission became MOST and the National Environmental Protection Agency became SEPA.

investments and subsidies in land development, rural works, and rural enterprises, the PRC has made commendable progress in reducing rural poverty from 260 million in 1978 to 34 million in 1999 using the PRC definition of rural poverty.[24] However, since 1997, there has been growing concern about urban poverty in the PRC. This reflects growing urban unemployment brought about by industrial enterprise reforms and government downsizing, in particular, retrenchment of excess employees of state-owned enterprises (SOEs). In 1998, 6.1 million industrial workers were laid off, most of whom could find other jobs. In 1999, the number of layoffs increased to 3.0 million or about 2 percent of the urban workforce, of which about 60 percent will be re-employed. In 1998, there were 5.3 million urban poor with 3.3 million drawing unemployment benefits to meet their basic necessities. Around 600 cities and 1,200 counties have established programs to ensure minimum living expenses. Assistance has been provided to the Government in developing an analytical framework for addressing the increasing relative urban poverty.[25]

23. In 1998, the average annual per capita disposable incomes in urban areas of the three provinces involved in the Project were lower than the national average of Y5,458 (i.e., Y5,042 for the Xinjiang Autonomous Region, Y4,292 for Heilongjiang Province, and Y4,646 for Liaoning Province). All three provinces have developed programs to address urban poverty. The economic structure of the northeast part of the PRC, comprising the provinces of Heilongjiang, Liaoning, and Jilin, has been dominated by heavy industries and SOEs with relatively inefficient production processes. Many SOEs have become unsustainable in the context of the market-oriented reforms. The performance of most heavy industries and SOEs has deteriorated. As a result, growth of the region's per capita income has been below that in other provinces, SOE-based social welfare has become strained, and the number laid-off workers has increased. The official unemployment rate in the various cities in the region is 3 percent but would be close to 15 percent if all laid-off and underemployed workers were included. With regard to the rural incomes in the three provinces in 1998, the average per capita income in rural areas in the Xinjiang Autonomous Region was Y1,600 which was lower than the national average of Y2,162 while the average annual per capita rural incomes for the other two provinces were higher than the national average (Y2,253 in Heilongjiang Province and Y2,579 in Liaoning Province).

24. In January 1999, the Government issued a series of regulations specifying the establishment and administration of unemployment and social insurance funds for the laid-off workers. The provincial and municipal governments in the three provinces under the Project are planning to address the growing urban poverty problem by (i) promoting the development of the local economies and increasing private businesses offering employment opportunities; (ii) introducing preferential access policies for the urban poor in the areas of education, water, electricity, heating, and gas in the form of fee exemptions or reductions; (iii) providing preferential policies to private and nonstate enterprises that employ laid-off workers; (iv) developing physical infrastructure (especially roads and water supply) to promote economic development and employ laid-off workers for construction; and (v) providing microcredit, tax exemptions, and retraining to laid-off workers who show self-reliance and establish private businesses.

[24] The PRC considers an annual income of Y635 per capita as the poverty line. ADB uses a per capita income of $1 per day or Y875 (on purchasing power parity basis) per annum as the international poverty line for rural areas and a per capita income of $3 per day for urban areas. (Poverty Reduction Strategy [R179-99] circulated to the Board on 19 October 1999).

[25] TA 3377-PRC: *Urban Poverty Study*, for $410,000, approved on 27 December 1999.

2. Environmental Strategy

25. The Government's environment sector objectives are to (i) bring environmental pollution under control, (ii) improve the quality of the environment in major cities, (iii) reduce degradation of natural ecological systems, and (iv) integrate environmental planning with economic and social development efforts. The Government's environmental objective for the year 2000 is to arrest degradation in the environment by improving air and water quality in 52 major cities where pollution is most severe. The basic policies and guiding principles include pursuing a strategy of sustainable development by integrating environmental protection programs into national economic and social planning, and establishing an effective environmental regulatory framework and management systems in both urban and rural areas. The aim is to contain the worsening trend of environmental pollution and ecosystem degradation, and improve the environment in some cities to demonstrate that rapid economic growth and a cleaner environment can be achieved simultaneously. To achieve these objectives, the Government aims to increase annual environment-related investments from 0.7 percent of GDP in the seventh five-year plan (1986-1990) to 1.3 percent during the NFYP.[26]

26. According to the national policy statement of the State Council in 1996, air and water pollution are to be stabilized at 1995 levels, and all enterprises will have to comply with air emission and wastewater discharge standards by the year 2000. Meeting this goal will require reductions in pollution intensity (unit of pollution per unit of production) since there will be continued industrial growth. Significant progress has been made in controlling pollution in some sectors, such as reducing emissions from power plants and closing small-scale polluting enterprises and power plants with a capacity of 50 MW or less. Meeting the State Council's goal requires massive investments in pollution prevention and control efforts. The Government has allocated $54.2 billion equivalent for direct environmental investments in the NFYP period. Of this, $25 billion (46 percent) is for prevention and control of air pollution, $22 billion (40 percent) for prevention and control of water pollution, $6 billion (11 percent) for control of solid wastes, and $1.2 billion (3 percent) for other categories of pollution prevention. The environmental improvement focuses on pollution related to power generation and heating systems; construction and building materials industry; water resources and water supply; and chemical, metallurgical, and pulp and paper industries.

27. Under the TFYP, the Government is expected to strengthen its control of pollutant discharge through the issuance of Regulations on Total Pollutants Control for selected cities and designated river basins and regions to support targets for environmental improvement. Ecological protection will be given equal importance as pollution control, and environmental protection of agriculture will be strengthened.[27] Sustainable urban development will be strengthened through the construction of centralized heating systems and sewage and solid waste treatment plants in large and medium-sized cities. Air quality in cities is to be improved through the substitution of gas for coal, where feasible; modernization and closing of polluting industries; and increased use of technologies and fuels that minimize pollution from vehicular emissions. Also, automated air quality monitoring networks will be established in large and medium-sized cities and continuous monitoring of water quality along stretches of several major rivers will begin. To achieve these objectives, the Government will strengthen institutional and

[26] This target has not yet been achieved; in 1999, environment-related investments were equivalent to about 1.0 percent of GDP.

[27] Among others, development of highly efficient, low-pollution green fertilizers, organic fertilizers, and natural biological pesticides is to be promoted; use of biomass as fuel is to be encouraged; and technologies for water efficient irrigation and control of water erosion are to be improved.

regulatory frameworks and increasingly introduce MBIs for effective environmental management. In this context, the Government is planning to prepare and promulgate a law on environmental impact assessment (EIA) which will require that strategic environment assessments be made for all proposed national planning and policy development activities and that possible environmental impacts be fully integrated in the decision-making process. ADB will assist SEPA in this regard.[28] Under the TFYP the Government will promote the concept of a "green" civil society emphasizing the benefits of sustainable environment-friendly development through green labeling of products, food, and energy which have been produced accordingly. The Project will support the Government's efforts to increase the supply of such energy in the PRC.

3. Energy Sector Strategy

28. The Government's overall objective for development of the energy sector up to 2020 is to reduce the growth in coal consumption and the environmental pollution that coal consumption causes. The Government is promoting (i) the introduction of clean coal technologies throughout the entire process of coal production, handling, transportation, and consumption; (ii) where possible, substitution of natural gas, hydropower, and renewable energy for coal; and, (iii) demand-side management to decrease the growth rate in energy consumption. To increase natural gas consumption, the Government is planning to undertake (together with private investors) major gas infrastructure projects, including the construction of (i) long distance transmission pipelines to transport natural gas from known gas fields in the western part of the country to the coastal provinces in the east,[29] and (ii) a terminal and related facilities at Shenzhen in Guangdong Province for the importation of liquefied natural gas (LNG).[30] Natural gas consumption is projected to increase from the present level of about 24.5 billion m^3 per annum to about 100 billion m^3 per annum by 2010. This will require major investments in new gas infrastructure of more than $50 billion and it will increase the natural gas share in the primary commercial energy mix from about 2.4 percent at present to 4-6 percent. Although the share of natural gas would still be modest, the 75 billion m^3 per annum increase in natural gas consumption will reduce coal consumption by about 155 million tons per annum, SO_2 emissions by about 2.2 million tons per annum, TSP emissions by about 0.7 million tons per annum, carbon dioxide (CO_2) emissions by about 52 million tons per annum, and solid waste by about 26 million tons per annum.

29. The Government's main objective in the power sector during the NFYP has been to increase investment in power facilities to support the country's economic growth and improve access to electricity. Given that the demand for additional power is largely being met, emphasis is being placed on (i) rationalizing power tariffs to reflect economic costs; (ii) improving efficiency and reducing emissions of existing power plants;[31] (iii) sector restructuring toward competitive markets and further commercialization and corporatization of power utilities; (iv) improving power transmission and distribution, including rural electrification, and (v) diversifying financing for power development, including private sector participation through

[28] TA 3290-PRC: *Capacity Building in Ministerial Status Responsibilities in SEPA*, for $810,000, approved on 8 November 1999.

[29] Including pipelines (i) from Zhongxian in Sichuan Province to Wuhan in Hunan Province and Shanghai, (ii) from Shanganning in Shaanxi Province to Xinyang in Hebei Province and Shanghai, (iii) from the Qaidam basin fields in Qinghai Province to Lanzhou in Gansu Province, and (iv) from the Tarim basin fields in the Xinjiang Autonomous Region to Lanzhou in Gansu Province and Xian in Shaanxi Province; it is envisaged that the pipelines will be operational by early 2005.

[30] It is expected that the terminal will be able to receive and vaporize about 3 million tons of LNG per annum which would provide about 4 billion m^3 of natural gas per annum for consumption in Guangdong Province.

[31] The Government announced in June 1999 the closure of thermal power generating units with a capacity of 50 MW or less. As a result, about 30,000 MW of small coal-based plants will be closed by 2003.

the build-own-operate and build-own-transfer approaches, shareholding, and other modes. This agenda has been supported by ADB's operations in the PRC power sector.

30. The power sector is being transformed from a centrally administered and operated system to a decentralized system whereby more autonomy is given to the regional and provincial/municipal power utilities. The role of the Government is being transformed from direct administration and operations to management through legal and regulatory mechanisms. Power utilities are to operate on a commercial basis to make them more responsive to market forces. In line with its reform agenda, the Government has formed regional electric power group corporations and provincial power companies (PPCs) and is transferring the management and operation of power facilities from regional network administrations and provincial electric power bureaus to such new entities. ADB has provided assistance to study options for further power sector restructuring, including the introduction of competitive markets in the different segments of the power sector, and to develop sector structures required to support such markets, using the East China and Northeast Power Region as model system.[32] Pilot projects have been initiated in six provinces (Shandong Province, Zhejiang Province, Shanghai, Liaoning Province, Heilongjiang Province, and Jilin Province) to determine the optimum strategies for separating power generation and transmission activities. The impact of power sector restructuring on wind-based power generation is expected to be minimal in view of the Government's plans to create a separate market for renewable energy under the TFYP. This will require to source a certain percentage of electricity from renewable energy resources, including wind-based power generation, and distribute the same to consumers (para. 31).

4. Renewable Energy Strategy

31. Traditionally, the Government has aimed to develop renewable energy to (i) diversify power generation, (ii) accelerate rural development, (iii) develop sustainable renewable energy resources, and (iv) derive environmental benefits from clean renewable energy resources. However, compared to the available potential, the PRC's renewable energy program is relatively small. At present, only about 18.7 GW of renewable energy capacity (mostly in the form of small hydropower) has been harassed out of an estimated potential of more than 350 GW. In 1996, the Government formulated its Program on New and Renewable Energy Development (1996-2010), which aims at improving the efficiency of renewable energy technologies, reducing production costs, and increasing the use of renewable energy. Among other things, it targets the installation of 400 MW of grid-connected wind farms by 2000, and 1,500 MW by 2010. Although the target for 2000 will not be met, that for 2010 will most likely be surpassed. Under the TFYP, the Government is planning to gradually introduce the requirement that 5 percent of the electricity supplied to consumers be generated from renewable energy resources, thus maintaining their present share in the generation mix. About 18 GW of new renewable energy capacity would need to be added until 2010 to achieve this objective. Such a policy will create a secure long-term market for renewable energy resources, in which potential investors would be willing to invest.[33] TA to develop the policy and implementation guidelines for the TFYP is to be provided under the Government's Strategic Partnership for Renewable Energy Development from GEF and the World Bank.

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[32] TA 2917-PRC: *Power Sector Restructuring*, for $804,700, approved on 24 November 1997. UNDP is also providing assistance for power sector reform; UNDP's assistance is focused on training, capacity building, and identification of issues while ADB's TA will recommend specific industry and market structures for the model region.

[33] Required investments are estimated at more than $8 billion up to 2005 and at about $12 billion for 2005-2010; for financing the projected increase in wind-based power generation, only more than $1.7 billion will be required until 2005 and about $3.0 billion from 2005 until 2010.

E. External Assistance to the Sector

32. Development of renewable energy resources in the PRC is being supported by GEF; UNDP; the World Bank; bilateral agencies from Denmark, France, Germany, Japan, Netherlands, Spain, United Kingdom, and United States; and ADB (footnotes 1, 5, 6, and 7). The largest financial support has been provided by the World Bank under its renewable energy development project. The project includes a wind farm component for installation of 190 MW at various sites; a solar PV component for installation of 300,000-400,000 PV systems in various provinces for power generation; and a technology improvement component to provide financial assistance to local industries producing equipment for wind-based or PV power generation.[34]

33. Since 1979, UNDP has supported eight projects, totaling $9.8 million, to introduce wind-based power generation and geothermal and PV technologies. At present, UNDP is providing assistance for capacity building to promote demand-driven development of the PRC's renewable energy sector and facilitate for rapid commercialization of renewable energy technologies.[35] Activities supported by the UNDP project include establishment of a Center for Renewable Energy Industries Association; development of demonstration projects for biogas production and wastewater treatment in livestock farms and alcohol distilleries, bagasse co-generation plants in the sugar industry, and renewable energy systems for rural electrification; and capacity building for renewable energy resource assessment, investment promotion in renewable energy, and evaluation of renewable energy projects.

34. Bilateral donors have mainly focused on installation of PV systems (sometimes in combination with diesel-fueled power generation) and development of grid-connected wind farms. Denmark and Germany have sizeable programs for installation of wind farms in the PRC. Germany, through mixed credits provided by the Kreditanstalt für Wiederaufbau, has provided financing for the construction of six wind farms with a total capacity of about 58 MW.[36] Denmark has financed through mixed credits the construction of nine wind farms with a total capacity of about 142 MW and has proposed to the Government to provide financing for another four wind farms with a total capacity of about 120 MW over the next three years.

F. Lessons Learned

1. Environmental Improvement Projects

35. ADB has made 14 loans totaling $2.0 billion for urban environment improvement projects in the areas of water supply, wastewater treatment, air and water pollution control and management, clean forms of energy, and industrial relocation and pollution abatement. The projects have addressed environmental problems in nine major cities (Beijing, Chengdu, Dalian, Hefei, Qingdao, Shanghai, Tangshan, Tongchuan, Xi'an, and Xianyang, all of which are on the Government's list of 52 priority cities for pollution control), as well as energy efficiency and environment improvement in key industry sectors, by introducing advanced process technologies and management practices to reduce inefficiencies and waste. As part of the policy dialogue supporting the loans, ADB has promoted price reforms to ensure sustainable resource utilization.

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[34] On 5 May 1999, the World Bank approved a $100 million concessionary loan for the project which is also supported by a $35 million grant from GEF. The project is not yet effective pending finalization of power purchase agreements (PPAs) for the wind farms.

[35] Foreign exchange financing mobilized for the project totals $14.3 million, comprising $8.8 million from GEF, $3.0 million from Australia, and $2.5 million from the Netherlands; implementation is from March 1999 until December 2003.

[36] Four wind farms with a total capacity of about 36 MW have already been completed.

36. Improving environment management has been a major focus of ADB's TA operations in the PRC. ADB has provided about $62 million for 100 TAs in such areas as environmental policy, regulatory measures, institutional building, economic incentives, replacement of obsolete technology with environment-friendly technologies, reduction of excessive reliance on coal, energy pricing and efficiency, water, natural resources, and hazardous waste management. ADB has also supported institutional strengthening of agencies involved in environmental management and preparation and review of EIAs; improvement and enforcement of environmental standards; development of environmental legislation; and dissemination of information on environment-friendly technologies and equipment. The TAs have also helped promote energy conservation, natural resource management, clean technology, renewable energy, and formulation of environmental policy on national and global issues.

37. A comprehensive conducted in 1998 found that ADB's strategic objectives for the energy and environment sectors since 1991 as well as their evolution over time have been appropriate.[37] ADB has played an effective role in assisting the PRC in the environment sector and has made advances in expanding its policies on social concerns.[38] The loan projects addressing environmental problems in several major cities have been generally successful. The Qingdao project is almost complete but the benefits are expected to be below appraisal estimates because of a reduction in scope.[39] Most components of the Tangshan and Chengde project[40] have been completed, except for the recently approved wastewater treatment facilities and reformation of old kilns at Tangshan that will be completed by the middle of 2000. Full benefits are expected from this project. After experiencing an initial delay, the Beijing project is now proceeding smoothly—except for the components related to the disposal and treatment of hazardous wastes that have been cancelled as alternative arrangements have been made for the treatment—and will be completed by December 2000.[41]

38. The Anhui project[42] is proceeding well and is expected to be completed by the end 2000. However, the implementation of the Xi'an-Xianyang-Tongchuan project[43] may incur some delay due to the need to review the suitability of the Project's scope. The Suzhou Creek Rehabilitation Project[44] became effective in February 2000 and is being implemented while the Shanxi Environment Improvement Project[45] is expected to become effective shortly. Of the two industrial energy conservation projects that involved technological restructuring, the first was completed in 1997 and ranked partly successful because of..[46] The second is proceeding ahead of schedule and will be completed in 2000,[47] but lack of counterpart resources has also led to the deletion of one out of six subprojects. Despite such implementation problems in some

[37] CAP:PRC 98026: *Country Assistance Program Evaluation in the People's Republic of China*, Doc. No. IN. 29-99, circulated to the Board on 25 January 1999.
[38] Operations Evaluation Office. 1999. *Special Evaluation Study on Social and Environmental Impacts of Hydropower Projects*. Asian Development Bank, Manila.
[39] Loan 1205-PRC: *Qingdao Environment Improvement Project*, for $103 million, approved on 10 December 1992.
[40] Loan 1270-PRC:*Tangshan and Chengde Environment Improvement Project*, for $140 million, approved on 25 November 1993.
[41] Loan 1336-PRC: *Beijing Environment Improvement Project*, for $157 million, approved on 29 November 1994.
[42] Loan 1491-PRC: *Anhui Environmental Improvement Project for Industrial Pollution Abatement*, for $112 million, approved on 26 November 1996.
[43] Loan 1543-PRC: *Xi'an-Xianyang-Tongchuan Environment Improvement Project*, for $156 million, approved on 24 September 1997.
[44] Loan 1692-PRC, for $300 million, approved on 19 June 1999.
[45] Loan 1715-PRC, for $102 million, approved on 7 December 1999.
[46] Project Completion Report on *Industrial Energy Conservation and Environment Improvement Project* (PCR: PRC 25012), circulated to the Board on 17 September 1999.
[47] Loan 1436-PRC: *Second Industrial Energy Efficiency and Environment Improvement Project* , for $178 million, approved on 9 May 1996.

projects, the focus on energy efficiency and environmental issues has proven to be generally successful as savings in energy and other financial costs associated with environmental pollution are large enough to repay the loans on commercial terms. The contribution of ADB's substantial TA support in the environment sector is widely recognized in the PRC. This success was made possible by combining TA activities that demonstrate the benefits of investment in environment, with lending for implementing the strategies and projects outlined by the TAs.[48]

2. Energy Projects

39. ADB's experience in the PRC's energy sector in the PRC has shown that projects are generally well-planned and implemented smoothly. Executing Agencies and IAs have personnel with good technical skills and have made effective use of the training financed under ADB loans to build their institutional capacity. Compliance with covenants is generally acceptable although greater efforts are required to implement the policy-related covenants, particularly those relating to diversification of enterprise ownership at the micro level in line with project commitments and policy directions. The rigorous Government screening of the projects has a positive impact. Energy conservation have experienced some delays mainly because of their complex multi-component nature involving several IAs in different provinces. Delays have also occurred for some projects in loan signing and loan effectiveness, as well as in procurement, construction, and commissioning. The Government is streamlining the multiple approval process to address these problems.

40. Power utilities have been found to be weak in the area of commercial and financial management. Often, there is a need for institutional strengthening in the areas of organization structure, delegation of authority, management, information and control system, accounting and financial management, and personnel development and training. So far, 2 out of 13 power sector projects financed by ADB in the PRC have been completed; these are the Fuel Conversion Project[49] and the Shanxi Liulin Thermal Power Project.[50] The project completion and project performance audit reports for these projects indicated that they had been implemented smoothly and assessed them as generally successful. Some cost increases as well as minor delays were noted. Recommendations from the experience gained highlighted on (i) the need to improve financial reporting; (ii) the need for more attention to environmental matters; (iii) the advisability of using larger boiler-turbine units; and (iv) the importance of capacity building not only for project preparation, but also for training staff in operational and managerial aspects of power utility operations. A recent reevaluation of the Fuel Conversion Project has revised the project rating downward to unsuccessful in economic terms and concluded that ADB-financed projects in the energy sector should not be narrowly focused on expected economic gains which may not materialize and should be rigorously screened to ensure that they are in line with ADB's energy policy. Recently, also some ongoing power projects in the PRC have shown a deterioration of overall project implementation in terms of meeting procurement and construction deadlines. This appears to be mainly due to the ongoing restructuring of the power sector and uncertainty about the ownership of the projects. Nevertheless, the overall implementation performance of ADB's energy portfolio in the PRC is satisfactory.[51]

41. The above lessons have been taken into account in designing the Project. Comprehensive feasibility studies have been prepared for the three wind farms, and consulting

[48] Operations Evaluation Office. 1997. TA Audit Report on *Selected TAs in the Environment Sector in the People's Republic of China*. Asian Development Bank, Manila.
[49] Loan 880-PRC, for $330 million, approved on 21 December 1987.
[50] Loan 1091-PRC, for $65 million, approved on 25 July 1991.
[51] Of 17 loans currently under administration, 5 are rated as highly satisfactory, 9 as satisfactory, 2 as partially satisfactory, and 1 as unsatisfactory.

services will be provided to assist with project implementation. Domestic commercial banks have committed their respective loans, which have been further secured through guarantees from relevant provincial government agencies. Local currency financing has been structured to ensure an appropriate mix of debt and equity. Provision has been made for sufficient working capital requirements for each wind farm to be established. Sensitivity analysis of financial and economic performance has been undertaken. PPAs which govern the sale and dispatch of the electricity to the grid, will ensure that the wind farms will be used whenever sufficient wind is available.

G. ADB's Strategy

42. ADB's operational strategy in the PRC is aimed at helping the country achieve economic growth in an efficient, equitable, and sustainable manner. Accordingly, three strategic objectives —efficiency improvement, environmental protection, and promotion of growth in less developed inland provinces—provide the focus for ADB's operations. In the energy sector, ADB's operational strategy supports the Government's two-pronged energy development program aimed at expanding energy supplies and promoting energy conservation and end-use efficiency. ADB encourages private sector participation in the PRC's energy sectors and is helping create the enabling environment for such private sector participation.[52] Energy projects are designed to assist in improving the efficiency of the economy in a sustainable manner while protecting the environment and managing the country's natural resources.

43. ADB's energy sector operations will focus on (i) promoting energy conservation and demand and supply side management; (ii) supporting improvements in transmission and distribution systems to promote system-wide efficiency and reduce losses, including improvement of the reliability and affordability of rural electricity supply; (iii) developing cleaner energy sources such as hydropower, clean-coal technologies, natural gas, methane gas, and renewable energy; (iv) renovating and retrofitting existing facilities to improve efficiency and reduce emissions; (v) promoting the corporatization and commercialization of power utilities; (vi) sector restructuring; and (vii) pricing and tariff reforms. This is complemented by ADB's strategy for the environment sector, which focuses on (i) strengthening the legal, policy and regulatory framework for sustainable environmental management; (ii) supporting institutional building programs in environmental monitoring and enforcement; (iii) supporting the utilization of economic, supply-side, and other measures to ensure sustainable utilization of natural resources; (iv) promoting the use of cleaner technologies for industrial production; (v) promoting market-based pricing and encouraging cost recovery; and (vi) implementing and monitoring agro-industrial pollution control mechanisms.

44. ADB's poverty reduction strategy for the PRC envisages a range of measures: (i) in the short term, providing goods and services directly to the most vulnerable members of society; (ii) in the medium term, improving health, education, and social security systems by supporting institutional reform and capacity building; and (iii) long term, promoting sustainable, pro-poor growth by improving infrastructure and creating jobs in areas with a high incidence of poverty. Since the PRC does not have access to concessionary loans from ADB, it has been reluctant to borrow for projects that address short- and medium-term poverty reduction measures. The

[52] In this regard, ADB provided TA 2730-PRC: *Changsha BOT Power Project*, for $597,000, approved on 23 December 1996, to help select the BOT operator and developing a project structure for a 2 x 350 MW coal-fired power plant near Changsha city in Hunan Province. ADB also provided financing of $50 million under its private sector operations to Fujian Pacific Electric Co. Ltd. of the PRC (Investment No. 1610/7144-PRC, approved on 26 February 1998, consisting of a loan of $40 million and an equity investment of $10 million) for Meizhou Wan BOT Power Project comprising a 720 MW coal-fired power plant in Fujian Province despite the different market environment in 1998, the latter project won two international awards for excellence.

Government and ADB have therefore agreed that poverty issues should be tackled from the following perspectives: (i) providing the necessary physical infrastructure in the poorer interior provinces, particularly in poverty counties, to stimulate economic growth; (ii) designing infrastructure projects to more broadly distribute the project benefits in poor areas; (iii) encouraging natural resource management to sustain agricultural production of poor areas, and targeting agriculture and rural development projects towards the poor; (iv) supporting social security reform and the development of a social safety net to offset the social costs related to SOE reform and ameliorate the increasing urban poverty; (v) ensuring that affordability by income level is considered during policy dialogue related to cost recovery (e.g. lifeline tariffs); (vi) ensuring that resettlement components of projects and environmental impacts do not result in worsened standards of living; (vii) paying special attention to the effects of projects on women and minority groups; (viii) looking more broadly at the poverty situation by working with the Leading Group of Poverty Alleviation of the State Council; and (ix) developing specific poverty reduction activities for financing by the Japan Fund for Poverty Reduction (JFPR).

45. ADB's assistance in the energy sector of the PRC will be aligned with the three pillars of ADB's poverty reduction strategy, i.e., pro-poor sustainable economic growth, social development, and good governance. Energy projects will be formulated and designed to support pro-poor growth, in particular in the poorer interior provinces to achieve balanced regional development. The Project, with its emphasis on promoting the development of environment-friendly power generation while maximizing its benefits for the poor and vulnerable groups is in accord with ADB's strategy to promote pro-poor and environmentally sustainable economic growth in the PRC. [A specific poverty reduction component is being formulated which is to be financed JFPR and incorporated in the Project to maximize the Project's benefits for poor and vulnerable groups].

H. Policy Dialogue

46. Dialogue under the Project has focused on the supportive policies and measures, which the Government should undertake to accelerate the development of renewable energy projects, in particular grid-connected wind farms. The issues discussed to promote renewable energy development and ensure the sustainability of the wind farms are described below.

1. Promotion of Wind Power Development

47. As a result of the policy dialogue, the PPCs that distribute the electricity generated by the wind farms will be fully compensated for their cost of purchasing and distributing such electricity. This will help eliminate the risk of nondispatch of relatively more expensive wind-based electricity when sufficient production from conventional sources is available. The Government has agreed to permit the PPCs to fully charge the consumers of wind-based power (who share in the environmental benefits) for its use, and issue a notice to this effect. [It was proposed that the Government would consider requests for tariff increases (for consumers) for electricity generated by wind farms separately from tariff increases for electricity from conventional sources to facilitate this process. Also, in consumer billings the use of electricity generated by wind farms could be identified separately and duly certified to inform consumers of the specific quantity of “green electricity” used.

2. Barriers to Renewable Energy

48. A major impediment for further development of renewable energy in the PRC is the absence of a mandatory requirement that a certain percentage of the electricity supply is to be met from renewable energy sources. During the TFYP, the Government will introduce policies

and mechanisms ensuring that power producers generate 5 percent of their electricity from renewable energy, thus creating a separate market for renewable energy. Assistance for the development of such policies and mechanisms is expected to be provided by the World Bank/GEF through the Government's Partnership for Renewable Energy Development which has as its main objective the reduction of harmful environmental emissions from coal-fired power generation by developing sustainable commercial markets for electricity generation from renewable energy. However, it is expected that World Bank/GEF assistance for the partnership will become operational by June 2001 at the earliest and that several more years will be required before the appropriate regulatory and policy framework has been established that will make market-based approaches to renewable energy development and utilization viable.

49. Other barriers to renewable energy development will be addressed in the three provinces under the Project. These include the absence of targets for renewable energy development at the provincial level, unavailability of wind data, absence of indicative site-specific cost ranges for wind-based electricity, and lack of interest in the nongovernment sector to invest in wind farms. In view of the global environmental benefits associated with the Project, ADB has approached GEF for assistance in addressing these barriers and providing financial support for the construction of the three wind farms. The concerned GEF Program Manager has recommended the proposed GEF assistance for GEF work program inclusion as an intervention that supports the objectives of the GEF renewable energy partnership with the PRC. Given the magnitude of the investments required for development of additional renewable energy resources over the next ten years to meet the 5 percent renewable energy target, the mobilization of nongovernment funds for investment in wind farms is essential. Together with developing the policy and regulatory framework for renewable energy, the Project will serve as a model for the mobilization of nongovernment funds that could be replicated in other parts of the PRC.

3. Power Sector Restructuring

50. Power sector restructuring toward competitive electricity markets is expected to result in more efficient operations and a reduction in electricity tariffs for consumers. For the further development of grid-connected wind-based power generation, it is important that a separate market is created for the usually more expensive electricity generated in wind farms. The Government, in principle, has agreed to create such a market under its TFYP by requiring that a minimum of 5 percent of electricity be generated from renewable energy. Power sector reforms in the Heilongjiang and Liaoning provinces are, therefore, not expected to adversely affect the utilization of their wind-based power potential, including the wind farms to be established under the Project. ADB's continuing policy dialogue with regard to power sector restructuring is expected to help the development of a green credit trading system in the PRC. In particular, if progress is made in unbundling PPCs and corporatizing power generation plants, the number of parties which could participate and would be interested in green credit trading would increase considerably and strengthen the viability of such a system.

IV. THE PROJECT

A. Rationale

51. The PRC's heavy reliance on coal as its primary fuel has led to serious national and global environmental problems, notably air pollution.[53] The projected continuing dominance of

[53] Air pollution also contributes to acid rain, which is causing increasingly serious damage to forests, crops, aquatic life, and archeological treasures.

coal in the energy sector implies further increases in emissions of SO_2, NO_x, TSP, and GHGs. The PRC currently accounts for more than 10 percent of annual global energy-related GHG emissions, mainly in the form of CO_2 and methane (CH_4). Even with sharp declines in energy intensity, the continued economic growth will be accompanied by more than a three-fold increase in GHG emissions by 2020. The annual economic losses due to adverse health impacts and agricultural loss associated with coal-related air pollution are considerable, and reducing environmental damage from coal use is a high priority for the Government. The development of noncoal energy alternatives, such as renewable energy, is one of the means of limiting the increase in GHGs and other types of pollutants. With moderate action, the PRC could draw as much as 6 percent of its energy needs by 2020 from renewable energy resources as against 2 percent under the business-as-usual scenario.

52. It is in this context that the Government promotes the development of wind-based power generation, with the long-term objective of making medium and large-scale wind farms (15 MW to 100 MW) competitive with the long-run marginal cost of energy generation. To date, the development of grid-connected wind farms has not been carried out in a systematic and coordinated manner, and has been mainly financed through bilateral grants and concessionary loans. The total installed capacity at operational wind farms is only about 265 MW. In line with the Government's target to increase the installation capacity of renewable energy resources by 18 GW by 2010, wind-based power generation is envisaged to increase to about 2 GW by 2005 and about 5 GW by 2010. This will require investments of about $1.7 billion until 2005 and about $3.0 billion between 2005 and 2010.[54] The Project will accelerate the development of wind-based power generation in the Xinjiang Autonomous Region and in the Heilongjiang and Liaoning provinces. It represents a bottom-up approach to the development of wind-based power generation at the provincial level within the framework of the Government's national policies and targets for renewable energy development under the TFYP. GEF support will be provided under the Project to develop mechanisms for the implementation of such policies in the three provinces.

53. The Project will also benefit the poor in the three provinces where the wind farms are located. The Heilongjiang and Liaoning provinces have average urban per capita incomes that are below the national average while the average rural per capita income in the Xinjiang Autonomous Region is below the national average (para. 23). However, from the townships located near the sites of the wind farms, only Chaiwopu near the wind farms at Dabancheng in the Xinjiang Autonomous Region has an average rural per capita income that is below the national average.[55] [The Fact-Finding Mission received several proposals to help the respective local governments to reduce occurrences of poverty in the Project area including retraining of laid-off factory workers in Gaizhou county near the wind farm at Xiwaizi (for which the local government would be willing to use its tax income from the wind farm), installation of small hydropower units and small wind turbines for power generation in rural communities in the Xinjiang Autonomous Region; and drilling of water wells for semi-nomadic herdsmen at Chaiwopu township near the wind farm at Dabancheng. These proposals will be further examined with assistance from ADB financed social development consultants (who are expected to begin their work in May 2000) to determine whether JFPR support can be extended to any of the proposals.]

[54] Based on estimated capital cost for wind-based power generation of $1,000 per kilowatt (kW).

[55] The 1998 average per capita income data for the respective townships are: Y2,800 at Chaiwopu township (Dabancheng, Xinjiang Autonomous Region); Y2,000 at Gongnong Forest Farm (Fujin, Heilongjiang Province); and Y3,500 at Xiwaizi township (Liaoning Province).

54. Over its lifetime, the Project will avoid emissions of about 11,000 tons of SO_2, 7,400 tons of NO_x, 5,000 tons of TSP, and 1.9 million tons of CO_2. This is important in 1997 in all three provincial capitals, daily TSP pollution levels exceeded PRC and WHO standards for residential urban and rural areas (Appendix 4). [This will be updated during Project appraisal.] The Project will help ensure the supply of electricity to rural communities, given the plans of the respective PPCs to close down inefficient, and polluting coal-fired power plants with a capacity of 50 MW or less over the next five years. The Project is also expected to generate employment opportunities for skilled and semi-skilled labor in the operation and maintenance of wind turbines and related facilities. [During Project appraisal, the Government's agreement will be sought to give priority to the recruitment of unemployed skilled and semi-skilled workers.]

B. Objective

55. The principle objective of the Project is to produce electricity in an environment-friendly manner through the establishment of grid-connected wind farms in the Xinjiang and Heilongjiang and Liaoning provinces and thereby avoid emissions of SO_2, NO_x, TSP, and CO_2.

C. Scope

56. The Project will establish three grid-connected wind farms with a total installed capacity of 78 MW and provide TA for barrier removal and institutional strengthening for development of wind power. The Project includes the following components:

1. Part A: Construction of Wind Farms

(i) Xinjiang Autonomous Region

(a) 30 MW wind farm at Dabancheng No. 3 site, about 40 kilometers (km) southeast of the provincial capital, Urumqi; and

(b) 40 megavolt-ampere (MVA), 220 kilovolt (kV) substation and a 3-km double circuit 220 kV transmission line.

(ii) Heilongjiang Province

(a) 24 MW Fujin wind farm about 32 km east of the city of Fujin; and

(b) 2 x 16 MVA 66/10 kV substation and a 5-km double circuit 66 kV transmission line.

(iii) Liaoning Province

(a) 24 MW wind farm at Xiwaizi near Yingkou City (on the eastern shore of the Liaoning Bay); and

(b) 2 x 16 MVA 66/10 kV substation and a 5.5-km double circuit 66 kV transmission line.

2. Part B: TA for Barrier Removal and Institutional Strengthening

(i) benchmarking of tariffs for wind-based power generation;

(a) Developing of a methodology for determining appropriate tariffs for wind-based power generation taking into consideration site specific conditions, investment costs, and required efficiency of operations and financial returns for investors.

(b) Consulting with key government agencies, potential investors, provincial power companies, and financial institutions to reach agreement on the methodology to be used for this purpose;

(c) Assisting in the development of suitable PPAs for wind farms; and

(d) Training staff of wind power companies and relevant provincial government staff in the use of the benchmarking methodology and the preparation and use of PPAs.

(ii) commercialization of the WFCs;

(a) Undertaking feasibility studies on options for attracting private investors and nongovernment investment funds to the WFCs under the Project; and

(b) Studying the possible reorganization of existing WFCs at Dabancheng, including possible merger of these with the WFC under the Project to improve efficiency of operations at Dabancheng and attract nongovernment investment funds in the future.

(iii) implementation of national policy for renewable energy use at provincial level; and

(a) Developing of targets for renewable energy production and use for the three provinces;

(b) Formulating an implementation plan to meet such targets;

(c) Incorporating wind power projects into the regular power sector planning for the three provinces;

(d) Identifying possible mechanisms for certification of renewable energy production by issuing domestic trading of green credits; and

(e) Evaluating the suitability of NFFO and other market mechanisms such as RPS for development of renewable energy in the three provinces within the framework of the national policy for renewable energy development.

(iv) wind measurement in the Xinjiang Autonomous Region and Heilongjiang and Liaoning provinces;

(a) Wind measurement at about 25 promising sites for development of additional wind farms;

(b) Collection and transfer of data to national wind power data center, which is being established with support from UNDP; and

(c) Preparation of bid packages for wind farm development at specific sites and assistance in the evaluation of bids received.

(v) capacity building and training;

(a) Training of relevant staff of provincial planning commissions and PPCs, municipal governments, and provincial financing institutions and commercial banks in planning, appraising and developing wind farm projects, and

(b) Training the staff of the wind farm companies (WFCs) in business development and managerial skills.

(vi) dissemination of the experiences and achievements in the three provinces at the national level.

(a) Holding workshops and seminars to present and discuss the experience and achievements of the three provinces at the national level in the context of the Government's overall policies and objectives for renewable energy development; and

(b) Disseminating of the findings and results of the TA.

D. Technical Justification

57. The PRC has identified various regions with strong average wind speeds (wind belts), in which wind farms can be developed. The first is the northern wind belt which runs from north-northeast of the Xinjiang Autonomous Region (near Urumqi), to the middle and northern part of Inner Mongolia and then moves from the northeast of Inner Mongolia through the middle of Heilongjiang Province towards the People's Democratic Republic of Korea and Russia. The second wind belt is the coastal wind belt ranging from the coast near Hainan Island, through Fujian and Zhejiang provinces to Shanghai and Shandong, Hebei and Liaoning provinces. The three proposed wind farms sites are situated in these two belts.

58. The Xinjiang Autonomous Region has nine separate potential wind farm regions with adequate wind resources. One of the regions is in the Dabancheng area[56] where five sites have been identified in close proximity to each other with an estimated total wind-based power generation capacity of 1,000 MW. At Sites No. 1 and No. 2, there are three operational grid-connected wind farms with an installed capacities of 10 MW and 57.5 MW, respectively. Site No. 3, which can accommodate up to 200 MW of wind-based power generation capacity, has been identified for the installation of the 30 MW wind farm under the Project. The wind farm will be connected to an existing 220 kV transmission line that passes near the site.

59. The wind farm at Fujin in Heilongjiang Province will be located on a small range of hills named Bielanyinshan, on the Sanjiang plain. It will be the first wind farm in the province that has four main wind zones. The area where the proposed wind farm is to be located has the highest wind resource of these four zones and is situated on the top of a mountain with an approximately 8 km long ridge line, which varies in height between 240 meters to 473 meters above sea level. The area around the site has good access and the equipment can be readily transported to the bottom of the hill site. Under the Project, an access road will need to be

[56] The area is easily accessible from the main highway and consists of a sparsely populated, wide open plain without much vegetation, flanked at two opposing sides by mountains, thus creating a corridor from the area around the city of Urumqi to the eastern part of the Xinjiang Autonomous Region.

constructed to transport the wind turbines and related equipment and materials up to the site. The wind farm is to be connected to an existing 66 kV transmission line which is located about 5 km away from the site.

60. The wind farm at Xiwaizi in Liaoning Province will be located near the eastern shore of the Liaoning Bay. The topography of the site is relatively flat but there is a 20-m high cliff near the location of the wind farm which may introduce some turbulence effects that will need to be addressed during the design. Access to the site is good but will require some upgrading by strengthening several small bridges and widening several curves to allow long trucks to pass. The wind farm will be connected to an existing 66 kV transmission line that passes near the site. There are five operational wind farms in Liaoning Province with a total installed capacity of about 50 MW. The PPC is planning to increase the wind-based power generation capacity to about 195 MW by 2005.

61. For all sites, the analysis has been made on the assumption that 660 kW wind turbines will be installed; however, this does not preclude the use of larger size turbines (850 kW to 1.5 MW). The 660 MW turbine size has been selected as it is suitable for all sites. Larger size wind turbines would yield similar amounts of energy; a decision on whether to use such turbines will be made during bid evaluation based on the micro siting of the turbines proposed by the bidders and the prices quoted by them.[57] Only international companies have the capacity and required experience to manufacture the wind turbines.

62. Existing wind farms in the PRC seldom reach an availability of 85 percent or more because of poor maintenance practices compounded by the debt-repayment type of PPA commonly used. It is envisaged that an overall availability of 98-99 percent will be achieved for the wind farms to be established under the Project[58] because the manufacturers of the wind turbines will be made responsible for the initial operation and maintenance. This will reduce potential risks with regard to the initial operation of the wind farms. The initial involvement of wind turbine manufacturers in the Project will also help ensure the availability of spare parts during the lifetime of the wind farms. Further, the manufacturers will train personnel of the WFCs in operation and maintenance which will enable the latter to assume full responsibility about one year after project completion. The PPAs will also provide incentives for efficient operation of the wind farms and maximum availability of the wind farms.

63. Electrification ratios expressed as the number of households that have access to electricity are relatively high with 88.9 percent for the Xinjiang Autonomous Region, 99.5 percent for Heilongjiang Province, and 99.0 percent for Liaoning Province. The provinces have ongoing programs for further rural electrification. Though just a fraction of the total power distributed in each province,[59] the power to be generated in the wind farms under the will help in meeting the demand for electricity and stabilizing the power distribution systems during further expansion and restructuring of the respective power generation base, which includes the closure of old, inefficient, and polluting coal-fired power plants.

64. The present tariff structures in the three provinces are relatively complex, do not fully reflect the structure of supply costs, and do not provide adequate incentives for energy conservation. The industrial consumers, who usually take electricity at higher voltage levels

[57] The installed capacity of each wind farm will differ slightly from the intended installed capacity if only 660 kW wind turbines are used.
[58] The 57.5 MW wind farm at Dabancheng's Site No. 2 achieved an availability of 95 percent in 1999.
[59] About 1.40 percent of the electricity distributed through the Urumqi power grid; about 0.22 percent of the electricity distributed through the Heilongjiang power grid; and about 0.18 percent of the electricity distributed through the Liaoning power grid.

(hence at lower costs) are paying a tariff that is higher than the tariff for residential consumers. Within the same consumer category, consumption at lower voltage level is charged at higher tariff, but the difference is small compared with the difference in supply costs. The tariff structures involve economic subsidies but are being modified to promote the efficient use of electricity. Appendix 5 presents the status and outlook for the power sector for each province.

65. Programs to eliminate rural surcharges and increase rural electrification that began in 1998 have resulted in a substantial reduction of rural tariffs in the three provinces. However, the current rural residential tariffs are still about 1.5 to 2 times the urban residential tariffs, amounting to Y0.60/kWh for the wind farm at Dabancheng, Y0.76/kWh for the wind farm at Fujin, and Y0.70/kWh for the wind farm at Xiwaizi. The PPCs have been (i) increasing urban residential tariffs, (ii) increasing the capacity charge for large industrial consumers, and (iii) increasing the number of consumers with time-of-day tariffs. Tariff reforms required to make electricity affordable to poor rural consumers will be discussed further with the Government on the basis of the findings of an ongoing TA.[60]

E. Cost Estimates

66. The total project cost including taxes, physical and price contingencies, and other charges during construction, is estimated at $98.7 million comprising a foreign exchange cost of $68.8 million and a local currency cost of $29.9 million equivalent (Table 1). Part A accounts for $92.7 million, and the TA under Part B for $6.0 million. Detailed cost estimates are given in Appendix 6.

Table 1: Project Cost ($ million)

Item	Foreign Exchange	Local Currency	Total Cost
Part A: Wind Farms			
Dabancheng Wind Farm	20.1	9.4	29.5
Fujin Wind Farm	16.8	8.2	25.0
Xiwaizi Wind Farm	16.8	7.2	24.0
Subtotal Base Cost	53.7	24.8	78.5
Contingencies	4.4	3.1	7.5
Interest During Construction	5.9	0.8	6.7
Total Part A	64.0	28.7	92.7
Part B: Technical Assistance	**4.8**	**1.2**	**6.0**
Total Project	**68.8**	**29.9**	**98.7**

F. Financing Plan

67. The entire foreign exchange cost of Part A of the Project of $64.0 million is proposed to be financed by an ADB loan of $58 million and a zero-interest $6.0 million contingent loan from GEF (that is to be repaid after ten years if the Project is successful) under a joint cofinancing arrangement with ADB. The local currency cost of Part A of $28.7 million equivalent will be

[60] TA 3369-PRC: *Rural Electricity Supply Study*, for $700,000, approved on 26 December 1999.

financed by the PPCs through mobilizing equity participation in the respective wind farms from their own and other sources ($18.5 million), as well as by loans from domestic banks and/or financial institutions ($10.2 million equivalent). The entire cost of Part B of the Project of $6.0 million will be financed by GEF on a grant basis. UNDP, as IA for GEF-supported projects,[61] is formulating a specific request, which is expected to be considered by the GEF Secretariat in June 2000.The proposed use of the GEF contingent loan is an innovative tool that is to be provided to share with the WFCs the perceived performance risks associated with wind farms in the PRC and build confidence in the new technology. These performance risks comprise lower than expected wind speeds i.e., wind resource risk, and wind turbine reliability i.e., technology risk (new technology and operation and maintenance requirements and inadequate support from overseas wind turbine manufacturers in a fledgling market for grid-connected wind farms). Experience in the PRC shows that the operation and operation of wind farms have not always been up to international standards and that wind farms have been constructed on the basis of overly optimistic assumptions with regard to the expected wind speeds which has resulted in lower energy outputs than originally calculated in the feasibility studies with subsequent losses to the operators. PPCs are therefore reluctant to take on these risks and invest in wind farm development. In this context, the use of the GEF contingent loan should be seen as a financing mechanism that is temporarily used for merely balancing the higher risks and costs associated with developing the initial wind farms in an incipient market which is not at a level playing field with the market for conventional power generation[62] and it should not in any way be considered as a capital subsidy. The GEF contingent loan is to be repaid after 10 years following Project completion if the Project is successful. The Project is considered successful if during the three years prior to repayment the three WFCs have achieved an availability of more than 95 percent, complied with the financial covenants, and made a reasonable profit. If the Project is not successful, repayment of the GEF contingent loan is not required only if it can be established that the Project's lack of success is due to wind resource and/or technology deficiencies that were beyond the control of the WFCs. Table 2 presents the proposed financing plan for the Project.

68. The ADB loan will be from ADB's ordinary capital resources. The loan will carry a front-end fee of 1 percent, an interest rate to be determined in accordance with ADB's pool-based variable lending rate system for US dollar loans, and a commitment charge of 0.75 percent per year. The loan will have a repayment period of 20 years, including a grace period of 3 years.[63]

Table 2: Financing Plan ($ million)

Item	Foreign Exchange	Local Currency	Total	Percent of Total
Equity				
XEPC		7.0	7.0	7.0
HEPC		5.8	5.8	5.9
LEPC		5.7	5.7	5.8
Total Equity		**18.5**	**18.5**	**18.7**

[61] To date, GEF permits two IAs only to prepare proposals for GEF support, i.e., UNDP and the World Bank.

[62] In the future, gradual leveling of the playing field can be expected as a result of the introduction of a mandatory share for renewable energy in power generation under the TFYP and an increasing market for wind turbines which would lower the equipment costs and make wind-based electricity more competitive with electricity from conventional sources.

[63] The blending of the GEF contingent loan with the ADB loan provides a total loan of $64 million at the net effective interest rate of 5.9 percent which is close to the estimated weighted cost of capital for the PPCs at 6.0 percent and the present interest rate on local borrowings; the grant element in this financing arrangement is therefore marginal.

Loans				
ADB	58.0		58.0	58.7
GEF (Interest free loan)	6.0		6.0	6.1
Domestic Banks		10.2	10.2	10.4
Total Loans	**64.0**	**10.2**	**74.2**	**75.2**
Grant (GEF)	4.8	1.2	6.0	6.1
Total Project	**68.8**	**29.9**	**98.7**	**100.0**

G. Implementation Arrangements

1. Project Management

a. Part A

69. The Executing Agencies for Part A of the Project will be the respective PPCs: the Xinjiang Electric Power Company Ltd. (XEPC) for the wind farm at Dabancheng; the Heilongjiang Electric Power Company Ltd. (HEPC) for the wind farm at Fujin; and the Liaoning Electric Power Company Ltd. (LEPC) for the wind farm at Xiwaizi. They will be responsible for the timely mobilization of all project financing, including obtaining any foreign exchange required in addition to the funds made available by ADB and the GEF. To operate the wind farms, three WFCs will be established under the PRC Company Law. The establishment of separate WFCs is in line with the Government's policy for corporatization of power generation activities. It will also facilitate attracting nongovernment funds to the wind farms in the future and allow the wind farms to operate as independent entities in a separate market for renewable energy, which the Government plans to establish during the TFYP. XEPC, HEPC, and LEPC will be responsible for procurement; preparation of legal agreements for the respective wind farms including PPAs and land lease agreements; and disbursement of funds. For this purpose, the PPCs will establish project implementation offices (PIOs), be staffed with a project manager, an accountant, and a procurement specialist [prior to loan negotiations].

70. Each WFC will be the IA for the establishment of its respective wind farm. The concerned PPC will be the majority shareholder in each WFC with wholly-owned affiliated corporations as minority shareholders.[64] The WFCs will be responsible for site preparation, construction supervision, and liaison with the concerned provincial power company. They will be staffed adequately, initially for implementation of the Project and subsequently, for its operation and maintenance. [Details of the WFCs' organization, management, and staffing will be worked out during Project appraisal. Establishment of the WFCs will be a condition for the loan negotiations.]

b. Part B

71. The Executing Agency for Part B of the Project will be SP in cooperation with SDPC which [prior to loan negotiations] will establish a Project Management Office (PMO) to coordinate at the national level the various activities that will be carried out in the three provinces and disseminate the experiences and results of the activities. Other members of the PMO will include SETC, and MOST. The PMO will coordinate the activities with the respective

[64 The draft charter of the WFCs will be prepared prior to appraisal.]

provincial planning commissions, PPCs, and pricing bureaus. Domestic consultants will provide support to the PMO with regard to policy development, coordination of provincial activities, and promotion and dissemination of provincial activities.

2. Procurement

72. All goods under the Project, which are to be wholly or partly financed by the funds made available by ADB, will be procured in accordance with ADB's *Guidelines for Procurement.* The wind turbines and towers will be procured on a turnkey basis for each wind farm following international competitive bidding (ICB) among prequalified contractors.[65] Manufacturers of the wind turbines will be contractually responsible for the operation and maintenance of the wind turbines for about one year until staff of the WFCs have received adequate training to take over such activities. The associated transmission facilities will be procured through ICB or international shopping (depending on the contract value), and the civil works financed locally through local competitive bidding. The proposed procurement packages are shown in Appendix 7.

3. Consulting Services

73. All consultants financed by the funds provided by ADB will be recruited in accordance with ADB's *Guidelines for Use of Consultants*. For Part A, 30 person-months of international consulting services will be recruited by the PPCs to assist (i) the PIOs with the preparation of prequalification and tender documents for the procurement and installation of the wind turbines and towers, and (ii) the WFCs with construction supervision of the wind farms. The proposed outline of terms of reference for the consulting services are in Appendix 8.

74. For Part B, 100 person-months of international consulting services and 200 person-months of domestic consulting services will be recruited by ADB to provide assistance to SP. [The proposed terms of reference for the consulting services are to be finalized during the Appraisal Mission in consultation with SP, SDPC, the provincial planning commissions, and UNDP.]

4. Implementation Schedule

75. Implementation of Part A is expected to begin with site preparation work[66] to be undertaken by the WFCs, after the Government has formally approved the project feasibility study. The duration of site preparation work will be about six months. This will be followed by the selection of contractors for the manufacturing, erection, and initial operation of the wind turbines, and towers and the official launching of the Project.[67] Assuming that the official launching will take place by mid-2001, physical completion of the Project is scheduled by April 2003. The first wind turbines will arrive at the sites by early 2002 and start generation by April 2002, with all of them to be installed by the end of 2002. After trial operation, full commissioning of all wind turbines is expected to be completed by April 2003. The TA under Part B of Project will be implemented from mid-2001 until late 2003. The project implementation schedule is given in Appendix 9.

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[65] A sufficient number of qualified manufacturers of wind turbines in the range of 600 kW to 1.5 MW exists to ensure competitive bidding.

[66] Construction of access roads, power and water supply facilities, and site leveling.

[67] Official launching can take place when (i) all funding has been obtained, (ii) bidding documents have been completed, (iii) land has been acquired, and (iv) site preparation has been completed.

5. Governance and Anticorruption

76. During project processing, ADB's anticorruption policy was explained to central and local government officials. Attention was drawn to the section on fraud and corruption that was added to ADB's *Guidelines on Procurement*, particularly the need for bidders, suppliers, and contractors to observe the highest standards of ethics in the procurement and execution of ADB-financed contracts, and the sanctions to be applied if fraud and corruption are discovered. Similarly, the anticorruption provisions added to ADB's *Guidelines on the Use of Consultants* were discussed.

77. The Government is increasingly concerned with governance issues and has conducted well publicized campaigns against official corruption. ADB's Country Assistance Program for the PRC includes support to the Government in improving governance and providing incentives to reduce the incidence of corruption in the longer term. In 1997, ADB also provided TA to draft procurement regulations and standard bidding documents.[68] The six sets of draft regulations and the three sets of sample bidding documents produced under the TA contain provisions related to avoidance of corrupt or fraudulent practices, in accordance with ADB's anticorruption policy. This assistance culminated in the promulgation of a National Law on Tendering and Bidding of the People's Republic of China that became effective as of 1 January 2000. The law law, which covers key construction projects funded by the State and all externally funded projects, stipulates in Article 5 that bidding activities shall follow the principles of openness, fairness, impartiality and good faith. Article 6 stipulates that "no organizations or persons shall, by any means, limit or exclude legal persons or other organizations outside from other regions or systems from participating in the bidding procedure. No illegal interference in any form is permitted in the bidding process". Article 32 specifically prohibits bribes and collusion, while Articles 49 to 64 specify appropriate sanctions for all abuses of the law, including substantial fines and criminal prosecutions.[69]

78. In 1998, ADB provided TA related to the consulting industry and auditing that will also help to address the main elements of ADB's anticorruption policy.[70] Under the TA, consultants are assisting the Government in developing detailed guidelines for the selection and engagement of consultants, which increase transparency, take account of the principles of ADB's anticorruption policy, and provide for equal opportunity competition. Under another TA, consultants are providing assistance to help strengthen the Government's auditing system to conform with the requirements of the Audit Law and, as far as practicable, international auditing standards.[71] In particular, this TA helps (i) formulate government auditing standards and procedures; and (ii) design and implement an audit-training program to promote full and consistent adherence to such auditing standards and procedures by government auditors. When completed, this work should strengthen the Government's ability to detect fraud and corruption.

[68] TA 2845-PRC: *Establishment of National Procurement Regulation for the Public Sector,* $565,000, approved in 20 August 1997.
[69] In 2000, ADB is planning to provide follow-on TA for (i) *Implementation of the National Law on Tendering and Bidding*, for $500,000, and (ii) *Preparation of a Government Procurement Law*, for $500,000.
[70] TA 3138-PRC: *Regulatory Framework for the Engagement of Consultants*, $700,000, approved on 22 December 1998.
[71] TA 3103-PRC: *Strengthening the Government Auditing System,* $700,000, approved on 26 November 1998.

H. Executing Agencies

1. Organization

79. XEPC, HEPC and LEPC are all limited liability companies, wholly owned by SP. They are responsible for undertaking the generation, transmission and distribution functions related to the heating and electric power industry in their respective areas. Day-to-day operations of each company are the responsibility of a General Manager who is assisted by seven officers of Deputy General Manager rank, including a Chief Engineer and a Chief Accountant. Each company has a network of wholly owned subsidiaries and controlled shareholding companies that include power generating plants, power distribution offices, research organizations, power-related educational institutions, construction offices, and noncore business which are not related to the performance of the power utility functions. Each also has investments in other companies. The organization structures of the three companies are presented in Appendix 10.

2. Accounting and Financial Management

80. In each Executing Agency, a Finance Department is responsible for accounting and financial management. The Finance Department is under the overall supervision of the Chief Accountant/Deputy General Manager for Finance and Planning. Separate sections are responsible for tariffs, cost and management accounting, capital assets, head office accounting, and internal finance. The financial management functions of all the subsidiaries are supervised by the Head Office. The Executing Agencies use accounting systems, which are in accordance with internationally accepted accounting principles. The accounts are maintained at the level of the individual business units and are consolidated for the Executing Agency as a whole. The operating budget is prepared annually and reviewed twice a year.

81. The financial statements of each Executing Agency and its subsidiaries are audited by private external auditing firms. The financial statements are submitted to the Ministry of Finance and SP for approval. Each Executing Agency has its own internal audit division. Under the Project, the Executing Agencies and IAs will prepare annual financial statements consisting of income statements, sources and application of funds, and balance sheets. They will also maintain records adequate to identify goods and services financed from the proceeds of the ADB loan. Each will have its financial statements audited in accordance with generally accepted auditing standards by external auditors acceptable to ADB, and will submit to ADB, not later than nine months after the close of each fiscal year, certified copies of financial statements, audited accounts and the auditor's report in English.

3. Past Financial Performance

82. Financial performance of the three Executing Agencies has been satisfactory, despite a slowdown in their revenue growth in the last two years because of industrial restructuring and the effects of the Asian financial crisis. XEPC earned net profits and generated annual rates of return on net fixed assets of 4-7 percent in the period 1997-1998. As of the end of 1999, its total assets amounted to Y7.1 billion. The current ratio in that year was 1.0, the debt/equity ratio 60:40 and the debt service ratio 1.4 times.

83. HEPC's return on net fixed assets ranged between 2 percent and 4 percent in the period 1997-1999. As of the end of 1999, its total assets amounted to Y23.1 billion. The current ratio in that year was 1.3, the debt/equity ratio 33:67, and debt service ratio 1.3 times.

84. LEPC was officially established only in 1999 following the reorganization of the North East Power Group. Estimates are available for 1998, and consolidated accounts for 1999. In these two years, LEPC's return on net fixed assets ranged between 4 percent and 6 percent. As of the end of 1999, its total assets amounted to Y44.7 billion. The current ratio in that year was 2.2, the debt/equity ratio 29:71, and the debt service ratio 4.0 times.

4. Financial Projections

85. A summary of the past and projected financial performance of the three Executing Agencies is given in Tables 3-5 while the detailed financial projections are in Appendix 11. The projections indicate that the Executing Agencies will be able to maintain acceptable debt service ratios and thereby ensure repayment of their loans.

Table 3: Summary of Actual and Projected Financial Performance of XEPC

Indicator	Unit	1998	1999	2000	2001	2002	2003	2004	2005
Energy sales	GWh	6,399	6,892	7,400	7,900	8,400	8,900	9,400	10,000
Increase in energy sales	%	11.4	7.7	7.4	6.8	6.3	6.0	5.6	6.4
Average revenue	Y/kWh	0.276	0.350	0.385	0.435	0.492	0.556	0.628	0.691
Increase in average revenue	%	5.9	26.7	10.0	13.0	13.0	13.0	13.0	10.0
Net income	Y mln	13	129	389	354	410	508	555	672
Net fixed assets	Y mln	4,223	4,223	7,682	10,180	12,149	14,782	17,844	19,657
Capital expenditures	Y mln	1,043	1,043	3,149	4,248	3,596	3,790	2,395	2,463
Operating ratio	%	89	82	65	69	68	66	67	67
Return on net fixed assets	%	4.2	6.5	10.6	8.1	8.2	8.6	8.2	8.3
Debt service ratio	times	1.1	1.4	2.7	1.9	1.3	1.3	1.1	1.2
Debt/debt-plus-equity ratio	%	60	60	65	67	68	63	60	55

Table 4: Summary of Actual and Projected Financial Performance of HEPC

Indicator	Unit	1998	1999	2000	2001	2002	2003	2004	2005
Energy sales	GWh	27,766	28,162	28,800	29,500	30,300	31,200	32,100	33,200
Increase in energy sales	%	-1.8	1.4	2.3	2.4	2.7	3.0	2.9	3.4
Average revenue	Y/kWh	0.299	0.359	0.392	0.424	0.458	0.480	0.504	0.525
Increase in average revenue	%	1.8	20.0	9.0	8.2	8.0	5.0	5.0	4.0
Net income	Y mln	41	21	504	552	747	724	737	877
Net fixed assets	Y mln	12,793	9,335	12,571	14,591	15,591	16,848	17,087	17,021
Capital expenditures	Y mln	0	0	4,616	2,527	2,584	2,568	823	784
Operating ratio	%	99	99	92	90	90	92	93	94
Return on net fixed assets	%	3.3	1.8	8.3	8.2	9.1	8.5	8.3	8.8
Debt service ratio	times	1.8	1.3	1.1	1.6	1.6	1.2	1.2	1.2
Debt/debt-plus-equity ratio	%	40	33	41	48	52	54	54	53

Table 5: Summary of Actual and Projected Financial Performance of LEPC

Indicator	Unit	1998 [a]	1999	2000	2001	2002	2003	2004	2005
Energy sales	GWh	49,739	50,236	51,400	53,000	54,800	56,500	58,300	60,300
Increase in energy sales	%		1.0	2.3	3.1	3.4	3.1	3.2	3.4
Average revenue	Y/kWh	0.342	0.356	0.388	0.416	0.445	0.476	0.509	0.530
Increase in average revenue	%		4.1	9.0	7.0	7.0	7.0	7.0	4.0
Net income	Y mln	316	540	689	943	1,047	1,159	1,251	1,337
Net fixed assets	Y mln	13,765	14,167	17,200	19,723	23,914	28,231	30,540	31,087

Capital expenditures	Y mln		277	6,140	5,956	6,291	4,850	3,835	3,683
Operating ratio	%	98	98	96	93	92	91	91	91
Return on net fixed assets	%	5.2	4.5	8.1	9.2	9.0	8.7	8.3	8.1
Debt service ratio	times		4.0	2.7	1.7	1.5	1.4	1.4	1.3
Debt/debt-plus-equity ratio	%	21	29	33	36	39	39	37	35

[a] Based on LEPC's estimate.

I. Implementing Agencies

86. Each WFC will have a PPA for sale of its electricity to the concerned PPC. The tariff is computed for the first year of commercial operation to yield an annual return on equity of 15 percent and then assumed to remain constant in real terms during the life of the Project. Taking into account the wind conditions at each site, the plant factors[72] are estimated at 43.5 percent at Dabancheng, 44.7 percent at Fujin, and 28.3 percent at Xiwaizi. Based on these assumptions, the electricity purchase price for the PPCs is expected to range between Y0.50 kWh and Y0.79/kWh in 2003, i.e., above the PPCs' self generation costs of Y0.37-Y0.40/kWh. As agreed by the Government, the higher costs of wind power will be passed on by the PPCs to the electricity consumers. Because of the low share of wind power in the generation mix of the PPCs, the impact will be negligible (about Y0.0002/kWh or less than 0.05 percent of their present average electricity tariff).

87. The financial projections for the WFCs are given in Appendix 12 and are summarized in Table 6.

Table 6: Summary of Financial Projections of the WFCs

Indicator	Unit	2003	2004	2005	2006	2007
Dabancheng Wind Farm						
Installed capacity	MW	30	30	30	30	30
Plant factor	%	43.5	43.5	43.5	43.5	43.5
Generation	GWh	84.9	113.2	113.2	113.2	113.2
Net electricity sales	GWh	76.4	101.9	101.9	101.9	101.9
PPC Purchase Price	Y/kWh	0.53	0.56	0.58	0.61	0.64
Return on equity	%	37.7	15.0	17.9	21.7	24.9
Debt service ratio	Times	0.0	1.5	1.6	1.7	1.7
Debt/Debt-plus-equity ratio	%	74	75	73	71	69
Fujin Wind Farm						
Installed capacity	MW	24	24	24	24	24
Plant factor	%	44.7	44.7	44.7	44.7	44.7
Generation	GWh	70.4	93.9	93.9	93.9	93.9
Net electricity sales	GWh	69.0	92.0	92.0	92.0	92.0
PPC Purchase Price	Y/kWh	0.50	0.53	0.53	0.56	0.58
Return on equity	%	15.8	15.0	15.6	18.6	21.8
Debt service ratio	Times	0.0	1.7	1.6	1.7	1.8
Debt/Debt-plus-equity ratio	%	77	74	71	67	63

[72] The number of units generated in a year divided by the plant capacity and the number of hours in a year (8,760).

Xiwaizi Wind Farm						
Installed capacity	MW	24	24	24	24	24
Plant factor	%	28.3	28.3	28.3	28.3	28.3
Generation	GWh	44.7	59.6	59.6	59.6	59.6
Net electricity sales	GWh	43.8	58.4	58.4	58.4	58.4
PPC Purchase Price	Y/kWh	0.79	0.83	0.83	0.83	0.87
Return on equity	%	15.9	15.0	15.0	15.3	18.4
Debt service ratio	Times	0.0	1.6	1.6	1.6	1.6
Debt/Debt-plus-equity ratio	%	77	74	71	67	64

88. The financial projections indicate that the operations of the WFCs will be able to yield annual rates of return on equity well above 15 percent in nominal terms. Each company will be able to service the loan repayment requirements as they become due; the debt service ratios consistently exceed over 1.5 times. The debt-equity ratios will at no time be more than 80:20.

J. Environmental and Social Measures

a. Environment

89. ADB has classified the Project as environmental category "B". Each wind farm is an integral part of the environmental investment plans of the three provinces. As part of the feasibility study, initial environmental examinations (IEE) and summary IEEs (SIEEs) were prepared by the TA consultants (footnote 1). The SIEEs are given in (Appendix 13). [However, it is necessary to obtain environmental clearance from relevant environmental agencies along with the pre-feasibility studies approval for wind farms. Copies of the certification letter, either from SEPA or the provincial level environmental bureau as applicable, will be made available to ADB prior to Project appraisal.] The wind farms will generate significant benefits both to the national and global environments in terms of avoided air pollution from coal-fired power plants and reduced GHG emissions. On the negative side, there will be minor disturbances to the immediate surroundings during construction and operation of the wind farms. The IEEs indicate that such adverse environmental impacts can be easily mitigated by following standard norms of civil and construction engineering practices. Environmental management, mitigation and monitoring plans have been prepared as a part of the IEEs, and will be carried out to ensure sound environmental practices during construction and operation of the wind farms. In particular at Dabancheng care will be taken to prevent groundwater contamination as the site is located on gravel sediments that are the main source of potable water for the city of Urumqi.

2. Poverty Reduction and Social Dimensions

a. Pro-Poor Economic Growth

90. Clean energy projects such as wind farms contribute to poverty reduction by avoiding environmental pollution, which disproportionately affects the poor, and by creating new job opportunities. The installation of 78 MW of wind-based power generation under the Project will create a minimum of 390 job-years for operation and maintenance of the wind farms. The Project will also be instrumental in transferring wind turbine manufacturing technology from abroad to the PRC. Apart from reducing the cost of wind turbines, this would generate about

17 job-years for each MW manufactured in the PRC.[73] [Further possible options for strengthening the impact of the Project on poverty reduction in particular with regard to women and minority groups are to be finalized during the Appraisal Mission when the ADB-financed social development consultants will have completed their study (para. 45)].

b. Land Acquisition

91. Land acquisition for the wind farms under the Project will be done in accordance the Land Administration Law of 1998. The sites are not occupied by any settlements and hence, no relocation of people is required. With regard to the Xiwaizi wind farm, only the area used for foundations of the wind turbines, roads, buildings, and related equipment will be leased by the WFC from the Government for a period of 30 years. For this purpose, only about 2.5 percent of the area of about 167 hectares required during project implementation for installation of the wind turbines and construction of related facilities will have to be leased.[74] The land not leased by the wind farms will therefore continue to be used for agriculture. Adequate compensation will be paid to the original users of the land.[75] For the Fujin wind farm, a similar arrangement will be made with the exception that the land will be leased for an indefinite period and that owner of the site, the Forest Bureau, will be compensated for the removal of some 30-40 trees required for the construction of the wind farm. Growing of trees, which do not reach a height of more than 10 m, will continue in the area not required for wind farm operations.

92. With regard to the wind farm area at Dabancheng, the Kazakh ethnic minority herdsmen have been using the proposed site of the wind farm for cattle grazing during the seasons when grass is available. The rights to use the grassland are guaranteed under a 50-year agreement with the Government in accordance with the 1985 Grassland Law. The construction of the wind farm will reduce the grass available to them. It has been agreed that the Kazakhs herdsmen will be allowed to continue the practice of grazing their cattle during the lease of the land by the wind farm and that adequate compensation will be paid to them. [In accordance with the ADB's *Policy on Indigenous Peoples*, an *Ethnic Minority Development Plan* (EMDP) will be prepared with assistance from the ADB-financed social development consultants. The scope of impact will depend on the scope of the land area to be leased by the wind farm for a period of 30 years which is still to be decided. It will lease either the entire land area of 210 hectares over which the wind turbines and related facilities will be spread out, or only the area actually used for foundations of the wind turbines and related facilities. The EMDP will describe the scope of project impact, assess losses and define the compensation and other mitigating measures for the affected herdsmen.]

V. PROJECT JUSTIFICATION

A. Financial and Economic Analysis

1. Financial Analysis

93. Financial sustainability of the wind farms will be ensured by the cost recovery mechanism built into the PPAs between the WFCs and the respective PPCs. Appendix 14 describes the analysis carried out to determine the viability of each wind farm. Given the

[73] Based on recent European studies, published in Renewable Energy World Magazine, November 1999. It is also estimated that a minimum demand for wind turbines in the PRC in the range of 40-60 MW per annum would induce foreign manufacturers to establish manufacturing facilities in the PRC.

[74] The area required for construction is relatively large because for the installed capacity of 24 MW at Xiwaizi, about 36 adequately spaced wind towers with turbines of 660 kW each will have to be erected.

[75] Equivalent to about ten times the average annual crop yield of the area that can no longer be used for agriculture.

provisions in the PPAs, returns on equity will be no lower than 15 percent in real terms. The real financial internal rate of return (FIRR) for the Project is 8.0 percent (8.3 percent for the wind farm at Dabancheng; 8.2 percent for the wind farm at Fujin; and 7.6 percent for the wind farm at Xiwaizi). This is above the weighted average cost of capital which is in the order of 5 percent. A sensitivity analysis has been carried out to test the impact of adverse conditions on the viability of the wind farms. The results indicate that even under adverse conditions, the FIRRs of the individual wind farms would remain above 5 percent, as shown in Table 7.

Table 7: Sensitivity Analysis of FIRR

Case	Change	Dabancheng FIRR (%)	Dabancheng SI[a]	Fujin FIRR (%)	Fujin SI[a]	Xiwaizi FIRR %	Xiwaizi SI[a]	Overall Project FIRR (%)	Overall Project SI[a]
(1) Base case		8.3		8.2		7.6		8.0	
(2) Capital cost overrun	+10%	7.8	0.64	6.9	1.53	6.7	1.11	7.2	1.05
(3) Lower benefits	-10%	7.6	0.87	6.7	1.78	6.6	1.30	7.0	1.27
(4) Implementation delay	1 year	8.1		7.5		7.3		7.6	
(5) Combination of (3) and (4)		6.8		6.3		6.1		6.4	
(6) Devaluation of yuan	-20%	6.9	1.67	6.1	2.57	5.8	2.37	6.3	2.15

[a] Sensitivity indicator (percentage change in the EIRR divided by the percentage change in the given parameter).

2. Economic Analysis

a. Least-Cost Analysis

94. Least-cost generation expansion plans for the three provincial power systems were carried out by SP's Power Economic Research Center with the assistance of the PPCs. The input data and assumptions were reviewed by the TA consultants and the Mission, and found appropriate. The analysis covers the period 1999-2022, and uses constant 1999 prices and a discount rate of 12 percent. Tradable commodities were valued at border prices at the prevailing exchange rate. Non-tradable commodities were valued at shadow prices, using a mix of standard and specific conversion factors. The base case consisted of expansion of power generation through the proposed wind farms under the Project. The least-cost analysis shows that this base case is superior in terms of the present value of supply costs by alternative additional power generation options for all three power if the environmental benefits are taken into account. (Appendixes 14 and 15). The results of the least-cost analysis are also supported by the outcome of a levelized costs analysis, under which the investment and operation costs of run-of-river hydropower stations with similar environmental benefits are compared with the same costs of the wind farms under the Project. The levelized costs are Y0.36/kWh for the wind farm at Dabancheng; Y0.33/kWh for the wind farm at Fujin; and Y0.51/kWh for the wind farm at Xiwaizi, i.e., below the levelized costs of run-of-river hydropower stations with the same level of environmental benefits at Y0.37/kWh, Y0.52/kWh, and Y0.52 /kWh for the three provinces, respectively.[76]

b. Economic Internal Rate of Return (EIRR)

95. In the EIRR calculation, the same conversion factors, investment costs for generation, transmission and distribution, and fuel, operation, and maintenance costs, where applicable,

[76] Originally, a 24 MW wind farm at Taizili in Liaoning Province was included in the project scope; however, during processing, the wind farm was deleted because it did not represent the least cost option for expansion of the power system.

were used as in the least-cost analysis. The main benefits will be the incremental supply of electricity and environmental benefits, which were valued based on avoided costs of supplying equal amount of electricity as the wind-based electricity to be produced under the Project. On this basis, the economic internal rates of return (EIRRs) were calculated at 14.1 percent for the Project (13.6 percent for the wind farm at Dabancheng; 16.0 percent for the wind farm at Fujin; and 12.7 percent for the wind farm at Xiwaizi). [If global environmental benefits are excluded, the EIRR works out to 12.5 percent. If no environmental benefits at all are included, then the EIRR drops to 8.8 percent.]

c. Risks

A. 96. The Project is based on proven design. The proposed technology has been successfully used in the PRC as long as appropriately operated and maintained. Consequently, no significant technical risks are anticipated in the design, and operation of the equipment.[77] XEPC and LEPC already have experience in the construction of wind farms. All three Executing Agencies will set up separate PIOs staffed with experienced professional staff who have previous experience in designing and supervision of construction of civil works and wind farm projects. They will be assisted by project implementation consultants. The Project has been designed to further reduce the completion risk by constructing the wind farms on a turnkey basis and requiring that land acquisition is completed prior to the issuance of the bidding documents

B. for the turnkey contract. The marketing risk for the electricity produced by the wind farms has been addressed by the adoption of appropriate PPAs for dispatch and sale. The initial operation risk has been addressed by requiring that the turnkey contractors be responsible for operation of the wind farm during the first year.

97. Sensitivity analyses were carried out to test the impact of variations in some parameters (Table 8). The results indicate that capital cost increases, benefit reductions and implementation delays do not affect the viability of the proposed wind farms. Further, changes in the foreign exchange rate of the yuan would not constitute a major risk to the viability of the proposed wind farms. The tariff-setting mechanism allows the PPCs to recover all costs including operating costs and debt-service requirements and to earn a reasonable rate of return on net fixed assets.

Table 8: Sensitivity Analysis

		Fujin			Xiwaizi			Dabancheng			Overall Project		
	Change	EIRR (%)	SI [a]	SV [b]	EIRR (%)	SI [a]	SV [b]	EIRR (%)	SI [a]	SV [b]	EIRR	SI	SV
(1) Base case		16.0			12.7			13.6			14.1		
(2) Capital cost	+10%	14.1	4.16	24.0	11.1	24.8	4.0	11.9	10.4	9.6	12.4	8.08	12.4
(3) Benefits	-10%	13.8	5.50	18.2	10.8	28.0	3.6	11.6	12.2	8.2	12.0	9.76	10.2
(4) Implementation delay	1 year	13.8			10.8			11.6					
(5) Combination of (2) (3) and (4)		10.3			7.7			8.4			8.8		
(6) Devaluation of yuan	20%	12.4	2.9	34.4	9.6	17.4	5.8	10.6	6.7	15.0	10.8	5.7	17.7

[a] Sensitivity indicator (percentage change in the EIRR divided by the percentage change in the given parameter).
[b] Switching value (percentage change in the variable at which the Project's net present value becomes zero).

A.

98. To complement the sensitivity analyses, a probabilistic risk analysis was performed using the Monte Carlo simulation technique (Appendix 15). The expected EIRR for the Project based on the weighted average of all simulated combinations, is 13.9 percent, 0.2 percent lower

[77] At present, the largest turbine size in use in the PRC is 600 kW; however, larger sizes up to 1.5 MW based on the same technology are available worldwide, and are not expected to pose an additional technical risk.

than the base case value without consideration of project risks. Under the assumed distribution of the five main variables, the probability that the EIRR for the Project will be less than 10 percent is only 6 percent.

B. Environment

99. The Project's main environmental benefit will be a reduction in air emissions that would take place if the same amount of electricity were produced in coal-fired power plants (Appendix 15). The reduction in air pollutants has been valued on the basis of its positive impacts on human health and welfare in accordance with the approach outlined in ADB's workbook on *Economic Evaluation of Environmental Impacts*. The net present value of the environmental benefits from air quality improvement at the national level ranges from $8.7 million to $16.4 million, while the global impact from reduction of GHG emissions is estimated at $15.6 million to $35.1 million in net present value terms. The incremental cost analysis is in Appendix 16.

C. Social Dimensions

100. The Project will help accelerate the establishment of grid-connected wind farms in the PRC by removing impediments its further development of wind farms and providing institutional strengthening to promote such development. Increased use of wind farms for power generation will create a market for the local manufacture of wind turbines at lower costs and generate new employment opportunities. The Project will also be beneficial for the living conditions in the three provinces by avoiding air pollution and ensuring supply of electricity. Further, the Project will directly benefit a number of unemployed in the provinces by creating a minimum of 390 job-years for operation and maintenance of the wind farms and providing financing from the JFPR for [to be added after ADB-financed social development consultants have completed their work and a proposal for JFPR support can be formulated].

VI. ASSURANCES

A. Specific Assurances

101. The Government has given the following assurances, in addition to the standard assurances, which have been incorporated in the legal documents:

1. Environmental Management and Monitoring Plan

(i) The Government will ensure that all the project facilities will be constructed and operated in accordance with an environmental management and monitoring plan that will be prepared for each site that will be acceptable to ADB.

(ii) Through semiannual reports, the Executing Agencies will keep ADB informed about the preparation and implementation of the environmental management and monitoring plans.

2. Commercialization of the WFCs

(i) Following the completion of the study on commercialization of the WFCs under Part B of the Project the Government and ADB will discuss the various options for attracting private investors and nongovernment investment funds in the WFCs under the Project.

3. Financial Matters

a. Financial Matters Related to the Executing Agencies

(i) Each Executing Agency will have its financial statements audited in accordance with generally accepted auditing standards by external auditors acceptable to ADB, and will submit to ADB, not later than nine months after the close of each fiscal year, certified copies of financial statements, audited accounts, and the auditor's report in English.

b. Financial Matters Related to the WFCs

(i) Each WFC will earn at least a 15 percent rate of return on equity on an annual basis in real terms.

(ii) Each WFC will maintain a debt service coverage ratio of not less than 1.3 times.

(iii) By the third year of full operations, WFC will not exceed a debt-equity ratio of 75:25.

(iv) Each WFC will have its financial statements audited in accordance with generally accepted auditing standards by external auditors acceptable to ADB, and will submit to ADB, not later than nine months after the close of each fiscal year, certified copies of financial statements, audited accounts, and the auditor's report in English.

4. Social Dimensions

(i) The Government will ensure that the land lease and compensation plans prepared for each wind farm will be in accordance with the 1998 PRC Land Administration Law and ADB's *Policy on Involuntary Resettlement.*

(ii) For the wind farm at Dabancheng, the Government will ensure that the 1985 Grassland Law and ADB's *Policy on Indigenous Peoples* will be followed.

[B. Conditions for Loan Negotiations

(i) The Government will have established WFCs for the three wind farms.

(ii) The PPAs for the wind farms will have been prepared and initialed.

(iii) The feasibility reports for the Project will have been prepared and submitted to SDPC.

(iv) For the wind farm at Dabancheng, an EMDP acceptable to ADB will have been approved.

(v) The Executing Agencies will have established adequately staffed PIOs.

C. Conditions for Board Presentation

(i) The feasibility reports for the Project shall have been approved by SDPC].

D. Conditions for Loan Effectiveness

102. The Loan Agreement will have the following conditions of effectiveness (i) PPAs for all wind farms shall have been approved by SDPC; and (ii) GEF-ADB joint cofinancing agreement and documentation for GEF-financed TA for Barrier Removal and Institutional Strengthening shall have been executed.

VII. RECOMMENDATION

103. I am satisfied that the proposed loan would comply with the Articles of Agreement of ADB and recommend that the Board approve:

(i) the loan of $58,000,000 from the ADB's ordinary capital resources to the People's Republic of China for the Wind Power Development Project, with a term of 20 years, including a grace period of 3 years, front-end fee of 1 percent and with interest to be determined in accordance with the ADB's pool-based variable lending rate system for US dollar loans, and such other terms and conditions as are substantially in accordance with those set forth in the draft Loan and Project Agreements presented to the Board;

(ii) the administration of a loan of $6,000,000 to be provided by the Global Environment Facility to the People's Republic of China for the Wind Power Development Project; and

(iii) the administration of technical assistance to be financed by the Global Environment Facility on a grant basis in an amount not exceeding the equivalent of $6,000,000, to the Government of the People's Republic of China for Barrier Removal and Institutional Strengthening to promote wind power development.

TADAO CHINO
President

1 August 2000

APPENDIXES

- available at ADB or under preparation

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PROJECT FRAMEWORK

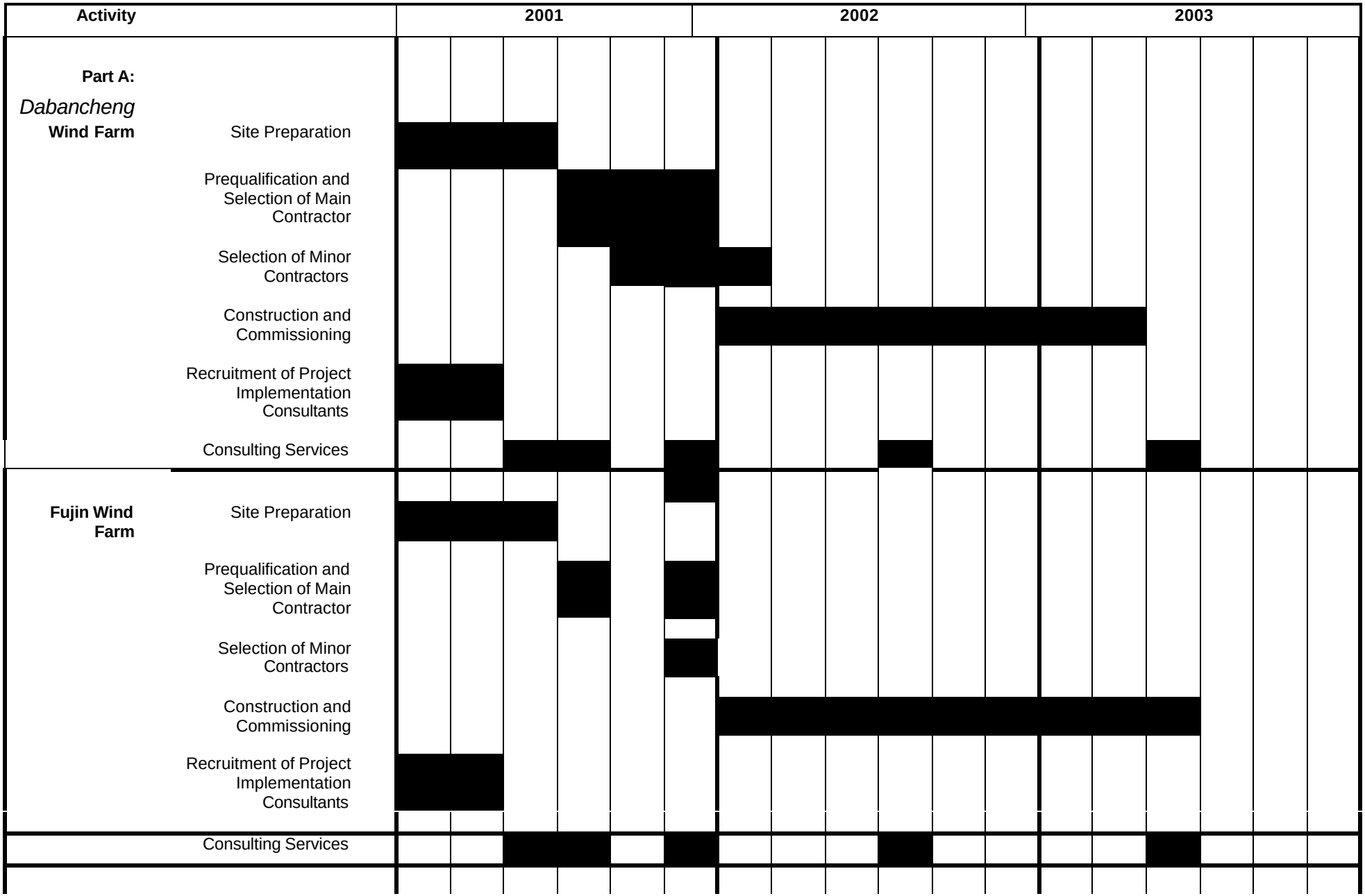
Design Summary	Performance Targets	Monitoring Mechanism	Assumptions and Risks
A. Goals			
Reduce adverse environmental impact of the power sector. Increase availability of electricity in rural areas .* Increase use of renewable energy for power generation.	Emission levels within prescribed limits. Sufficient supply to meet power demand. Increased electrification of households. Share of renewable energy in power generation mix of 5 percent over the next 5 years. Lower coal consumption per kWh generated.	National power sector and environmental reports and statistics. Country and sector consultation missions. Reports and statistics from the State Power Corporation. Reports and statistics on certification of renewable energy and trading of renewable energy certificates.	Funding constraints Slowdown in reform process and postponement of closure of old inefficient power plants. Economic slow down and decreasing growth in energy consumption. Implementation of suitable policies for renewable energy development.
B. Purpose			
Increase clean power supply. Reduce coal consumption. Reduce provincial air pollution. Increase power consumption in rural areas .* Remove barriers to further wind power development in the three provinces including the adoption of appropriate policies to promote renewable energy development.	Addition of clean renewable power capacity as follows: 30 MW in the Xinjiang Autonomous Region; 24 MW in Heilongjiang Province and 24 MW in Liaoning Province Extension of power service to rural areas and increased electricity sales in these areas .* Establishment of database for wind measurement in three provinces and setting targets for wind-based power generation over the next five years. Increased investments in wind-based power generation	New wind farm companies and provincial power companies annual reports. Air quality indicators Dated loan covenants for establishing and implementing. renewable energy policies. Provincial statistical yearbooks.	Slow power demand growth. Inability of the three provinces to mobilize the required counterpart funds. Inability to create an increasing annual demand for development and utilization of renewable energy.
C. Outputs			
30 MW wind farm at Dabancheng, including 40 MVA, 220 kV substation and 3 km of 220 kV transmission line	• Operation of new wind farms and sale of wind-based power to provincial power companies by 2002. • Provincial officials involved in energy development trained as scheduled.	• Project progress reports and ADB review missions. • Project completion report.	Levelized cost type of power purchase agreements will be used and provincial power companies will purchase and distribute all output from the wind farms.

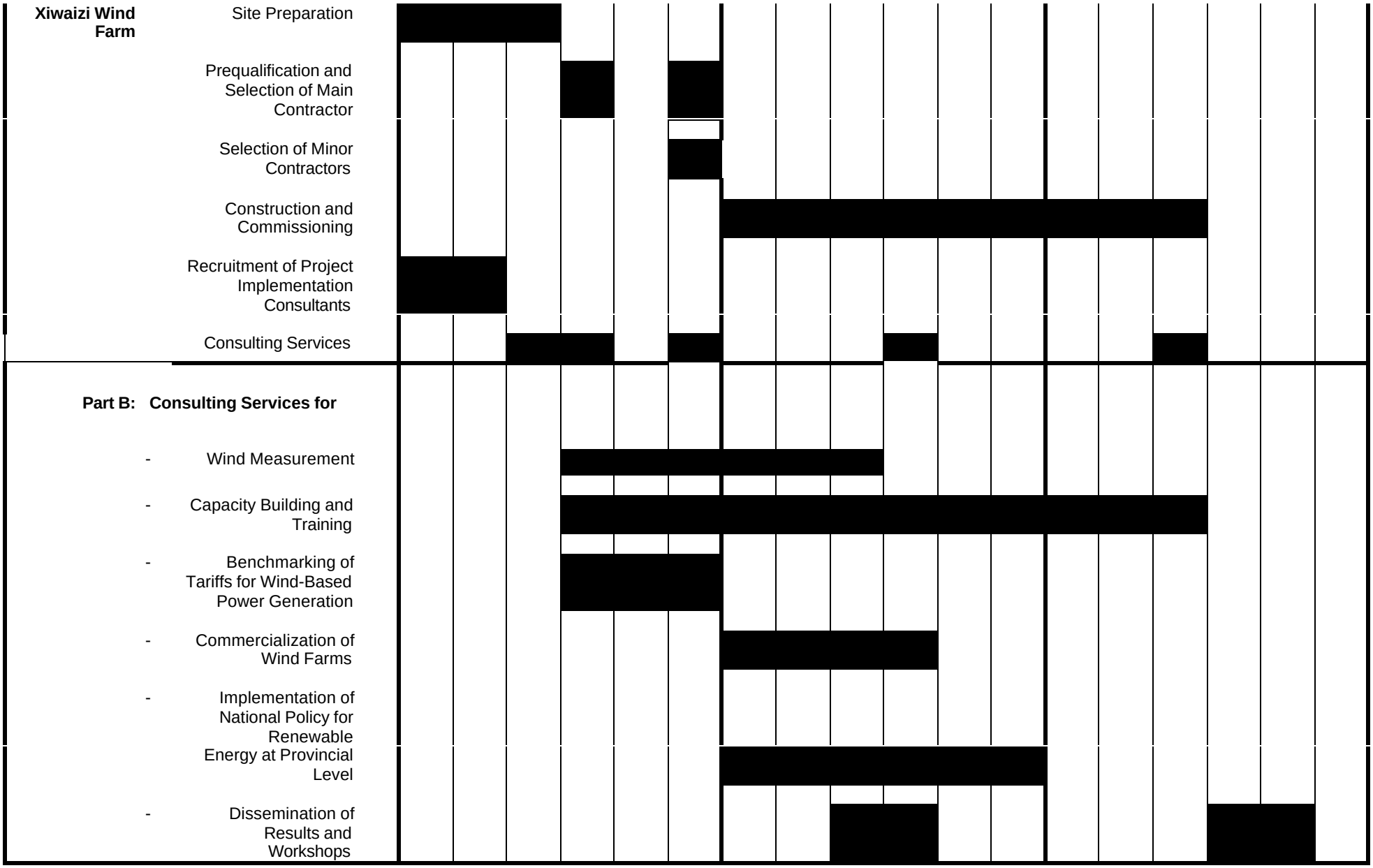
Design Summary	Performance Targets	Monitoring Mechanism	Assumptions and Risks
24 MW wind farm at Fujin including 2x16 MVA, 60/10 kV substation and 5 km of double circuit 66 kV transmission line 24 MW wind farm at Xiwaizi, including 2x16 MVA, 60/10 kV substation and 5.5 km of double circuit 66 kV transmission line New wind measurement data of 25 sites in the three provinces Training in capacity building for wind power projects. Identification of options for nongovernment investment in wind farms and preparation of bid packages to attract such investments Development of new policies at the concerned provincial level to accelerate the use of the wind energy in the three provinces	New policies for renewable energy resources development and use at the concerned provincial level are being implemented. Increased nongovernment investments in development of grid-connected wind farms.		Inefficient operation of the wind farms. Ineffective implementation of the provincial policies for promoting and accelerating the use of wind energy.
D. Inputs			
Equipment Civil works Training Consultants for (i) Project implementation, and (ii) barrier removal and institutional strengthening to accelerate development of grid-connected wind farms	• Project cost of $98.7 million • Funding sources as follows: ADB loan $58.0 million GEF loan $6.0 million stic bank $10.3 million GEF grant $6.0 million Equity $18.7 million	Project implementation progress reports Project accounts	Good performance by local contractors and consultants. Counterpart budget is available on a timely basis. Coordination and cooperation among the various Government organizations involved is satisfactory.

MW = megawatt; WVA = megavolt-ampere; kV = kilovolt; km = kilometer.

* The Project will help stabilize power supplies to rural areas and the project's impact on rural electrification will be assessed further during Project appraisal when JPFR funding of a rural electrification component under the Project will be evaluated.

PROJECT IMPLEMENTATION SCHEDULE




Xiwaizi Wind Farm
Site Preparation
Prequalification and Selection of Main Contractor
Selection of Minor Contractors
Construction and Commissioning
Recruitment of Project Implementation Consultants
Consulting Services
Part B: Consulting Services for
- Wind Measurement
- Capacity Building and Training
- Benchmarking of Tariffs for Wind-Based Power Generation
- Commercialization of Wind Farms
- Implementation of National Policy for Renewable Energy at Provincial Level
- Dissemination of Results and Workshops

SUMMARY INITIAL ENVIRONMENTAL EXAMINATION

A. Introduction

104. This Summary Initial Environmental Examination (SIEE) report covers the proposed Wind Power Development Project. The initial study was undertaken as a part of the ADB funded TA.[78] The Project is classified as Environmental Category B. The ADB Fact-finding Mission (Mission) visited the sites and held discussions with government agencies, local residents, and provincial power company staff, from 27 March to 7 April 2000. This summary IEE is based on the IEE reports prepared by the consultants, discussions during the Mission and the filed observations made by the Mission.

B. Description of the Project

105. Wind farms generate electricity without emitting any pollutants or using any non-renewable fuels; therefore, they offset the emissions produced by thermal (coal) power stations. The PRC is faced with severe air pollution problems, caused primarily by the burning of coal. Generating electricity with wind farms is a more environmentally friendly way of generating electricity than thermal power. The Project has four main components: (i) 30 MW Dabancheng wind farm in Xinjiang Autonomous Region, (ii) 24 MW Fujin wind farm in Heilongjiang Province, (iii) 24 MW Xiwaizi wind farm in Liaoning Province and (iv) institutional strengthening and capacity building.

106. The first component, the Dabancheng wind farm, is located in the valley between the eastern and central Tian Ranges (Tian Shan), with Bogda Peak to the northeast and Mount Gaishi to the west. It is near the villages of Chaiwopu (population about 1,000) and Dabancheng. The second component is located on Mount Bielayin, northwest of Jinshan Township (total population 24,000), Fujin City. Consisting of two hills on a general ridgeline running south to north, Mount Bielayin is on the Sanjiang Plain, south of the Songhua River. The Xiwaizi wind farm is the third component. It is located to the north of Xiwaizi, Chenjia, Xizhang and Xihi villages, Tuanshanzi Township (population 5,000), Gaizhou City, Liaoning Province. The wind farm is on a peninsula stretching out into the Bohai sea in the west with 2 km width and 3 km length. There was no IEE prepared for the fourth component since it will have no adverse environmental impacts as it involves only institutional strengthening and capacity building activities.

107. The wind farm development will consist of the following:

(i) Assuming a 660 kW wind turbine unit size, the wind farm will consist of 45 wind turbines, covering approximately 210 hectares.

(ii) The land permanently acquired for construction will cover 2.5 percent of the above nominal total area.

(iii) Upgrading the road to site, plus on-site roads to each wind turbine.

(iv) Foundations for wind turbine towers, transformers and switchyard/substation, including excavation, backfill and restoration of surrounding ground.

[78] TA 3071-PRC*: Wind Power Development Project*, for $590,000, approved on 21 September 1998.

(v) Overhead transmission line connecting to nearby existing transmission line.

(vi) Underground electrical cabling within the wind farm site.

(vii) Switchyard and transformers.

(viii) Operation and Maintenance facilities.

108. The wind farm construction will take one year, with most construction work taking place during the summer season. Construction activity would be reduced during the winter months due to the extreme cold.

C. Description of the Environment

	Dabancheng Wind Farm	**Fujin Wind Farm**	**Xiwaizi Wind Farm**
Climate:	The valley, where the Dabancheng wind farm is located, is 80 km in length, 20 km in width and broad and smooth in terrain. Surrounding the proposed wind farm is the Gobi Desert and desolate and boundless grasslands.	Moderate zone continental monsoon climate, distinct seasonal difference, windy spring with little rainfall, rainy and humid summer, abrupt drop of temperature in autumn.	Semi-humid continental monsoon climate with seasonal characteristics: early spring, rainy summer, cool autumn and cold winter. The predominant wind directions are southwest in summer and north in winter. Data from Gaizhou Meteorological Station shows:
Annual average temperature	6.6^{o}C	3.7^{o}C	9.6ºC
Maximum temperature	37.5^{o}C	34.5^{o}C	36.6ºC
Minimum temperature	-31.9^{o}C	-32.4^{o}C	-28.1ºC
Annual rainfall	65 mm	519 mm	656.5 mm
Average relative humidity	50 percent	68 percent	61 percent

	Dabancheng Wind Farm	**Fujin Wind Farm**	**Xiwaizi Wind Farm**
Average annual wind speed	8.4 m/s	9.2 m/s	6.8 m/s
	Dabancheng Wind Farm	**Fujin Wind Farm**	**Xiwaizi Wind Farm**
Soil	The proposed wind farm is located on Gobi/desolate desert with superficial fine particles blown off, but sand and dust exist under the earth surface. During foundation excavation, sand and dust will be exposed to the wind, causing wind-blown dust. This is inevitable, but appropriate measures can be taken to reduce the raised dust.	Black calcium-rich earth.	Surface earth is yellowish-brown clay with little gravel. Large amount of powder sand in the surface soil can be easily blown up by strong wind.
Surface Water	Since the average rainfall is low, no surface runoff will result. Even during occasional rainstorms, owing to the location of the wind farm on the valley slope, the runoff will flow down the slope.	The main source of surface water is the rainfall. High tree coverage on the hill results in high water reservoir capacity. No torrents occur in the heavy rain season.	The main source of surface water is rainfall. Due to high content of powder sand of the surface soil, rain water seeps quickly into the soil. During the heavy downpour season, rain water flows into the sea and may form seasonal waterlogged depression.
Groundwater	Melting snow from the mountains and rain form groundwater flows. The underground water is 25 m deep from the ground surface and is of good quality.	Underground depth of groundwater in Agricultural and Industrial Forest Farm is about 15 m. Water quality is up to the standard for	Groundwater depth is more than 3 m. There are wells for drinking water for local people.

	Dabancheng Wind Farm	Fujin Wind Farm	Xiwaizi Wind Farm
		drinking water .	
Ecological Resources			
Vegetation	Vegetation is sparse, with only desert plants like camel thorn. The coverage rate is 5 percent to 30 percent. The vegetation plays a role of windbreak and sand fixation. Hence during the construction period preventative measures should be taken to minimize damage to vegetation to avoid wind erosion of soil. There are no rare or protected plants in the wind farm or its vicinity.	The wind farm and its surroundings are mainly forest and small tracts of dry farmland. On the ridgeline and upper slopes is natural second-growth broad-leaf forest (main tree species 35 years old, 7 m high Mongolia oak) and small quantities of black birch. Down the hill there are plantation forest and small quantities of second-growth Mongolia oak. The coverage rate of plantation is around 95 percent. Corn is grown on the surrounding farmland. There are no rare or protected plants in the wind farm or its vicinity.	Mainly large tracts of dry farmland and small pieces of desolate land around the wind farms of low nutrient, high silt content, thin soil layer. The major crops on the farmland are sorghum and corn. There are locust trees and unevenly distributed shrubs on desolate desert. These are no rare or protected plants in the wind farm or its vicinity.
Wildlife	Due to sparse plantation and lack of food, there are few species and low numbers of animals in the area. It is not a major migration route for migratory birds. Workers of the No. 2 wind farm stated that no birds have struck the wind turbines	There are few species and low numbers of animals in the area. It is not a major migration route for migratory birds. Occasionally wild rabbit, magpie, and pheasant are found on Mount Bielayin. There is no rare wildlife.	There are few species and low numbers of animals in the area. It is not a major migration route for migratory birds. Only a few wild rabbits have been found in recent years.

	Dabancheng Wind Farm	Fujin Wind Farm	Xiwaizi Wind Farm
	during the years of operation. No wild rabbits were found in recent years.		

D. Human and Economic Development

109. The Mount Bielayin area is under the administrative jurisdiction of Fujin Industrial and Agricultural Forest Farm. There are 83 households, 351 people including 113 workers living in the area. The average income is about yuan 5,300 per year. The general area of Dabancheng supports a small population through farming and herding, with low levels of wealth. The Xiwaizi farm is located in the coastal area and most of the people make their living through fishing or agricultural work.

E. Cultural/Archeological/Historic Areas

110. There are no known areas of cultural or archeological/historical value in the wind farm area of Fujin. There are high mountains on both sides, an expressway in the north, and existing wind farms in the area of Dabancheng. The only areas of known cultural or archeological/historical values in the Xiwaizi wind farm areas are the Buddhist Monastery, ruined Watch Tower, and graveyard on waste land at the north end of the site.

F. Screening of Potential Environmental Impacts and Mitigation Measures

111. Since there is no widely used environmental impact checklist specific to wind power projects was available, ADB's checklists for hydro and thermal power stations, and transmission lines were collated, to give the list of parameters that are relevant to wind power projects.

112. **Land Acquisition**: Some of the wind farm areas will be covered by equipment, roads and buildings. However, the 2.5 percent ratio used for compensation is high by international standards, which means that in effect the payment for acquisition should more than cover the actual value of the lost land. This will allow some extra compensation to cover other effects. After construction, the remaining land will be available for continuation of present use. The only restriction on land use will be to ensure no interference with the operation (vehicle access, unimpeded wind flow). The trees are not expected to grow much beyond their present height of about 10 m.

113. **Visual Impact**: The Debancheng wind farm will not have any adverse visual impacts and there are already existing wind mills at the site. The proposed Xiwaizi wind farm is within Beihai Tourist Region, borders on the sea. The terrain is relatively smooth, mainly farmland and residential. The visual impact is generally considered not to be a problem by the locals, as they expect to get economic benefits from tourism. Officials in the local environmental protection bureau and the head of Buddhist Monastery believe the "wind farm construction will promote the local tourism development". The Fujin wind farm construction will disturb the ecological view in the site in a minor way. However, the wind turbines installed on the ridge will become a new feature for the area, with possible economic value through tourism. Mitigation measures to be taken are to ensure same shape, color and direction of blade rotation of all wind turbines. The access and site roads require cut and fill operations and cutting of trees which may result in

partial exposure of rocks or soil, with a degree of adverse visual impact. However, due to the requirements for replanting all exposed soil, the effects will lessen with time.

114. **Electro Magnetic Impacts** (**EMI)**: Investigations show no impact of the proposed wind farm on telecommunication, radio or TV services.

115. **Water Protection Area**: The Debancheng wind farm is located within the groundwater protection zone which supplies drinking water to Urumqi city. The wind turbines must be located at a specified distance from the existing wells. Strict preventive measures must be taken as required by the "Regulations on Pollution Prevention and Control in Drinking Water Sources Protection Zone" issued jointly by State Environmental Protection Administration, the Ministry of Health and the Ministry of Construction.

116. The Fujin area is forested and, subsequent to recent catastrophic flooding throughout northeastern PRC, the Government adopted a policy to limit tree cutting. The removal of some of the trees for the purposes of a wind farm must be mitigated in the form of planting an equivalent number of trees. These trees should be planted in an appropriate location, i.e., in terms of economic value (firewood), soil stabilization, supporting natural wildlife. In area of the Xiwaizi wind farm, the main source of water is rainfall. There will be no impact on water availability in the area because of the wind farm.

117. **Acoustic Noise**: There are no residences in the vicinity of the Debancheng wind farm. There is a residential area (population about 350) near the wind farm. Hence noise nuisance should be taken into consideration. The Buddhist Monastery is located close to the Xiwaizi wind farm and the standard noise levels must be enforced. A distance of at least about 300 m from the residences[79] should be considered when designing turbine layout to ensure the noise level of the residential area is in accordance with the Noise Standard (no higher than 45 dB(A) during the night).

118. **Wildlife**: During construction the transportation and excavation work will destroy the original silent environment of the Bielayin mountain at the Fujin wind farm. Thus there will be a degree of impact on wildlife, but the impact will be temporary due to short construction period. As for the operation period, the wind turbines are laid out in rows along the ridgeline with non-continuous human presence and no physical barriers to wildlife movement. Thus there is no expected large-scale impact on ecology/wildlife. To ensure no sudden impact due to higher numbers of people present, construction staff and operation and maintenance personnel should not be allowed to hunt wildlife.

119. **Dust**: The extent of pollution by suspended dust depends on wind speed, the ground cover plant life and ground humidity. There will be a limited influence of dust during road construction and transport of equipment.

[79] A greater distance is allowed since differences in wind speed with elevation will make the wind turbine noise more noticeable.

G. General Mitigation Measures

120. Construction activities will be confined to the acquired land, and avoid unnecessary damage to ecosystem and the surrounding plant life. The construction site will be cleared up after completion and restored to original functions of the land temporarily acquired. Priority will be given to refilling of excavated material, reducing the amount of discarded material and stockpiling surplus material at a designated place. Cleaning up the construction site after completion will mitigate the minor damage to the natural environment.

121. Depending on an adequate number of employed people during the operation period, permeation-proof sanitary toilets will be built. Oil containment structures will be installed around the transformer and oil-bearing sewage resulted from accidents and maintenance will be transported off site. Safeguard will be put in place to ensure no oil escapes during rainfall. Temporary toilets will be used on site during construction to reduce the environmental pollution. The construction period will be shortened to shorten the exposure time of dust. If any historical remains are found, measures will be taken to avoid damage.

H. Environmental Management and Monitoring

122. To manage the environment efficiently during the construction and operation periods, and ensure the implementation of suggested measures, the environmental impact assessment unit will undertake a monitoring plan. Generally, environmental management involves the project owner, the contractor and the local environmental protection department. The project owner manages environmental protection during construction and operation. The contractor is responsible for the implementation of environmental protection measures and the local environmental protection bureau supervises and monitors the environment. Local environmental monitoring stations or the project owner will assign full-time personnel equipped with necessary monitoring apparatus to the conduct environmental monitoring. A monitoring plan will be prepared to monitor the main impacts during construction and operation.

123. The environmental protection bureau will supervise and manage the environmental mitigation measures during construction. To identify environmental impacts of the wind farm during the operation period, environmental data will be collected to provide a basis for settling environmental disputes and routine environmental management. After completion of the wind farms, under full load conditions, the substation and transmission lines will be monitored initially in accordance with “Guiding Principles of Radiation Environment, Electromagnetic Radiation Monitoring Apparatus and Methodology”. Subsequently, the frequency of monitoring will depend on the results of the initial monitoring. In Fujin, the local Forest Bureau will manage the occupied area of the wind farm, the area of trees cut, destruction of plant life and recovery of plant life in the temporarily acquired land, in accordance with the “Forest Law of the PRC” and relevant rules and regulations. The noise level near the residential area and Fujin Industrial and Agricultural Forest Farm will be monitored.

I. Conclusion

124. All identified adverse environmental impacts are minor in nature. Using simple engineering designs and management measures, all potential adverse environmental impacts can be mitigated. Standard civil engineering measures can incorporate such mitigation measures into engineering designs. Wind power development in the PRC will have substantial environmental benefits due to its ability to replace highly polluting, coal based electricity

generation. Because of the nature of the Project, no detailed environmental impact assessment is needed.

FINANCIAL ANALYSIS OF THE PROJECT

125. Detailed financial analysis was conducted on the Project. Below are described the notes and assumptions used in the financial evaluation. All the costs and prices are expressed in constant 2000 prices.

1. Benefits

126. The first wind turbine will start generation from 1 April 2002 and all the wind turbines will be installed by the end of 2002. However, commercial operations are expected to begin by 1 April 2003 only. With this, for the financial analysis, the generation in 2003 will be 75 percent of the generation of the normal year operation. The wind farms will operate on the following plant factors: 43.5 percent for the Dabancheng wind farm, 44.7 percent for the Fujin wind farm, and 28.3 percent for the Xiwaizi wind farm. The revenues are calculated using the tariff as follows: tariff is computed for the first full year of normal operation to yield a return on equity of 15 percent and is assumed to remain constant thereafter in real terms. The project life is estimated at 20 years. The operating data for the three wind farms are shown in Table A13.1.

2. Costs

a. Capital Costs

127. The capital costs include physical contingencies but exclude interest charges during construction. The construction period will be about two and a half years. Salvage value at the end of 20 years is estimated at 25 percent of cost.

b. Operating Costs

(i) Operation and Maintenance Costs

128. Annual operation and maintenance costs are estimated at Y0.04/kWh in 2000 prices.

(ii) Fixed Cost

129. Fixed costs are estimated at about 1 percent of net fixed assets.

(iii) Interest Expenses

130. Financial expenses are the interest on loans incurred in Project implementation. Interest on foreign exchange loans is calculated at 6.46 percent and on local borrowings at 6.21 percent.

(iv) Income Tax

131. The Project's taxable income is subject to 33 percent income tax.

3. Financial Internal Rate of Return

132. The financial rates of return of the three wind farms are calculated as shown in Tables A13.2-A13.4 and that for the overall project is shown in Table A13.5.

Table A13.1: Operating Data of Wind Farms

			2000	2003	2004	2005	2006	2010	2022
Dabancheng Wind Farm, 30 MW									
	Installed Capacity (MW)			30.0	30.0	30.0	30.0	30.0	30.0
	Plant Factor (%)			43.5	43.5	43.5	43.5	43.5	43.5
	Generation (GWh)			84.9	113.2	113.2	113.2	113.2	113.2
	Net Electricity Sales (GWh)			76.4	101.9	101.9	101.9	101.9	101.9
	Network Transfer Tariff (Y/kWh)								
		Constant Prices (2000)		0.483	0.483	0.483	0.483	0.483	0.483
		Current Prices		0.528	0.555	0.582	0.611	0.743	1.334
Fujin Wind Farm, 24 MW									
	Installed Capacity (MW)			24.0	24.0	24.0	24.0	24.0	24.0
	Plant Factor (%)			44.7	44.7	44.7	44.7	44.7	44.7
	Generation (GWh)			70.4	93.9	93.9	93.9	93.9	93.9
	Net Electricity Sales (GWh)			69.0	92.0	92.0	92.0	92.0	92.0
	Network Transfer Tariff (Y/kWh)								
		Constant Prices (2000)		0.458	0.458	0.440	0.440	0.440	0.440
		Current Prices		0.501	0.526	0.530	0.557	0.676	1.215

Xiwaizi Wind Farm, 24 MW

Installed Capacity (MW)		24.0	24.0	24.0	24.0	24.0	24.0
Plant Factor (%)		28.3	28.3	28.3	28.3	28.3	28.3
Generation (GWh)		44.7	59.6	59.6	59.6	59.6	59.6
Net Electricity Sales (GWh)		43.8	58.4	58.4	58.4	58.4	58.4
Network Transfer Tariff (Y/kWh)							
	Constant Prices (2000)	0.722	0.722	0.685	0.652	0.652	0.652
	Current Prices	0.789	0.828	0.825	0.825	1.003	1.801

Table A13.2: Financial Internal Rate of Return: Dabancheng 30 MW

(Y million)

Average Revenue (Y/kWh, 2000 prices): 0.483

	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2010**	**2022**
Cash Flows (in constant 2000 prices)								
Revenues			31.1	41.5	41.5	41.5	41.5	41.5
Capital Costs	59.8	150.2	45.2					
Cash Operating Costs			6.9	8.0	8.0	8.0	8.0	8.0
Salvage Value								
Income Tax			6.3	3.7	4.2	4.9	6.6	6.9
Net Cash Flow	**-59.8**	**-150.2**	**-27.3**	**29.8**	**29.3**	**28.7**	**27.0**	**26.6**
Financial Internal Rate of Return (%)			**8.3**					

Table A13.3: Financial Internal Rate of Return: Fujin 24 MW

(Y million)

Average Revenue (Y/kWh, 2000 prices):				0.458					
		2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2010**	**2022**
Cash Flows (in constant 2000 prices)									
	Revenues			25.4	33.9	32.5	32.5	32.5	32.5
	Capital Costs	51.0	122.7	33.9					
	Cash Operating Costs			5.6	6.4	6.4	6.4	6.4	6.4
	Salvage Value								
	Income Tax			3.2	2.9	2.8	3.2	4.6	4.9
	Net Cash Flow	**-51.0**	**-122.7**	**-17.3**	**24.6**	**23.3**	**22.9**	**21.5**	**21.2**
	Financial Internal Rate of Return (%)			**8.2**					

Table A13.4: Financial Internal Rate of Return: Xiwaizi 24 MW

(Y million)

Average Revenue (Y/kWh, 2000 prices):				0.650					
		2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2010**	**2022**
Cash Flows (in constant 2000 prices)									
	Revenues			25.4	33.9	32.1	30.6	30.6	30.6
	Capital Costs	54.8	127.7	33.4					
	Cash Operating Costs			4.8	5.3	5.3	5.3	5.3	5.3
	Salvage Value								53.0

Income Tax				3.3	3.0	2.8	2.8	4.2	4.6
	Net Cash Flow	**-54.8**	**-127.7**	**-16.1**	**25.6**	**24.0**	**22.6**	**21.1**	**20.8**
Financial Internal Rate of Return (%)				**7.6**					

Table A13.5: Financial Internal Rate of Return: Overall Project

(Y million)

		2001	2002	2003	2004	2005	2006	2010	2022
Cash Flows (in constant 2000 prices)									
	Revenues	0.0	0.0	81.9	109.3	106.2	104.6	104.6	104.6
	Capital Costs	165.5	400.5	112.6	0.0	0.0	0.0	0.0	0.0
	Cash Operating Costs	0.0	0.0	17.3	19.7	19.7	19.7	19.7	19.7
	Salvage Value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	169.9
	Income Tax	0.0	0.0	12.8	9.6	9.9	10.8	15.4	16.5
	Net Cash Flow	**-165.5**	**-400.5**	**-60.7**	**80.0**	**76.6**	**74.1**	**69.6**	**68.5**
Financial Internal Rate of Return (%)				**8.0**					

ECONOMIC ANALYSIS OF THE PROJECT

A. Least-Cost Analysis

133. The least-cost generation expansion analysis covering 2000-2022 (planning period) for Heilongjiang Power Grid (HPG), Liaoning Power Grid (LPG), and Xinjiang Power Grid (XPG) were carried out by Beijing Economic Research Institute of Water Resources and Electric Power (BERI) using the GESP II model.[80] The input data and assumptions were reviewed by the Mission and found appropriate. The analysis used constant 1999 prices and a discount rate of 12 percent. Tradable commodities were valued at border prices at the prevailing exchange rate (Y8.3/$1.0). Nontradable commodities were valued at shadow prices, using a mix of standard and specific conversion factors.[81] The least-cost analyses confirmed the robustness of the proposed wind farms.

134. The results of the least-cost analysis are supported by levelized costs (LC) analysis. In the LC analyses, run-of-river hydropower stations with similar environmental benefits will replace wind farms. The analyses compare the investment and operation cost of wind farms with that of run-of-river hydropower stations. The main assumptions for the candidates, including the cost and generation, were found to be appropriate. The data were obtained from local design institutes and power companies.

1. Fujin Wind Farm

135. Fujin wind farm will be required by year 2002, with the projected electricity demand growth of 2.2 percent for the period of 1999-2001, 3.3 percent for 2003-2010 and 3.2 percent for 2011-2022 in Heilongjiang. Two least-cost generation expansion alternatives for HPG were considered. Alternative I is the basic case, which is to construct the 24 megawatt (MW) Fujin wind farm. In alternative II, Fujin wind farm will not be constructed. The present values of cost for Alternative I and II are Y218,060 and Y218,118 million, respectively. The results indicate that the least-cost generation expansion scenario including the Fujin wind farm compares favorably with the one without Fujin wind farm. The LC of Fujin wind farm is 0.33 Yuan/kWh, lower than the LC of run-of-river hydropower with similar environmental benefits (0.52 Yuan/kWh).

2. Xiwaizi Wind Farm

136. The Xiwaizi wind farm will be required by year 2002, with the projected demand growth of 2.4 percent during 1999-2001, 3.4 percent for 2002-2012 and 3.4 percent for 2011-2022 in Liaoning. Two least-cost generation expansion alternatives for LPG were considered. Alternative I is the basic case, which is to construct the 24 MW Xiwaizi wind farm. In Alternative II, Xiwaizi wind farm will not be constructed. The present values of cost flows for Alternative I and II are Y310,054 and Y310,063 million, respectively. The results indicate that the least-cost generation expansion scenario including the Xiwaizi wind farm compares favorably with the one without Xiwaizi wind farm. The results show that the LC of Xiwaizi wind farm is 0.51 Yuan/kWh, lower than the LC of run-of-river hydropower with environmental benefits (0.52 Yuan/kWh).

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[80] The computer model GESP II (Generator of Electric System Planning) has been used for similar analysis in more than ten power projects financed by the World Bank and the Bank.

[81] A standard conversion factor of 0.93 was used. Border prices were used for all import items. Local costs were shadow priced using group and specific conversion factors: 1.0 for equipment, 1.51 for steel, 0.69 for cement, 0.63 for timber, 2.0 for skilled labor, and 0.67 for unskilled labor. Taxes and duties were excluded.

3. Dabancheng Wind Farm

137. The Dabancheng wind farm will be required by year 2002, with the projected demand growth of 2.4 percent during 1999-2001, 3.4 percent for 2002-2012, and 3.4 percent for 2011-2022 in Xinjiang. Two least-cost generation expansion alternatives for UPG were considered. Alternative I is the basic case, which is to construct the 30 MW Dabancheng wind farm. In Alternative II, Dabancheng wind farm will not be constructed. The present values of cost flows for Alternative I and II are Y55,538 and Y55,564 million, respectively. The results indicate that the least-cost generation expansion scenario including Dabancheng wind farm is 0.36 Yuan/kWh, lower than the LC of run-of-river hydropower with environmental benefits (0.37 Yuan/kWh).

B. Economic Internal Rate of Return (EIRR)

138. The economic analysis used the conversion factors, investment costs for generation, transmission and distribution, fuel costs, and O&M costs that are consistent with those used in the least-cost analysis. For EIRR calculations, the benefits of energy output were valued based on avoided power supply cost. The economic benefits of wind turbines in EIRR calculations begin with the operation of each individual wind turbine. The results of the EIRR analysis show the generation and environmental benefits as the major benefits. The costs include (i) capital investments of wind farms, and (ii) incremental O&M costs calculated at 1.0 percent of the capital costs. EIRR calculation used a conservative approach that does not include the benefit of improved quality of supply. The environmental benefits were valued based on the "Benefits Transfer Method", used (i) methodology adopted in the Bank's *Workbook on Economic Evaluation of Environmental Impacts* (1996) to determine adjusted estimate of the monetary damages caused by air pollution during the study period, taking into account the location of the power plant, the emission level, and the population affected; and (ii) estimates of average annual climate change for carbon emissions to evaluate the monetary damages caused by greenhouse gas emissions. Sensitivity analyses on EIRR were also performed for each wind farm.

1. Fujin Wind Farm

139. The resulted EIRR for Fujin wind farm is 16.0 percent (A14.1). The sensitivity analysis showed the EIRR would decrease to (i) 14.1 percent if the Project were to experience a cost overrun of 10 percent; (ii) 13.8 percent if the benefits were reduced by 10 percent; (iii) 13.8 percent if the Project was to experience a commissioning delay of one year; and (iv) 10.3 percent if all (i), (ii), and (iii) happen. With only national environmental benefits, the EIRR will be reduced to 13.8 percent. Without environmental benefits, the EIRR would decrease to 8.9 percent. RMB depreciation of 30 percent will reduce EIRR to 12.4 percent.

2. Xiwaizi Wind Farm

140. The resulted EIRR for Xiwaizi wind farm is 12.7 percent (Table A14.2). The sensitivity analysis showed the EIRR would decrease to (i) 11.1 percent if the Project were to experience a cost overrun of 10 percent; (ii) 10.8 percent if the benefits were reduced by 10 percent; (iii) 10.8 percent if the Project was to experience a commissioning delay of one year; and (iv) 7.7 percent if all (i), (ii), and (iii) happen. With only national environmental benefits, the EIRR will be reduced to 11.6 percent. Without environmental benefits, the EIRR would decrease to 4.8 percent. RMB depreciation of 30 percent will reduce EIRR to 9.6 percent.

3. Dabancheng Wind Farm

141. The resulted EIRR for Dabancheng wind farm is 13.6 percent (Table A14.3). The sensitivity analysis showed the EIRR would decrease to (i) 11.9 percent if the Project were to experience a cost overrun of 10 percent; (ii) 11.6 percent if the benefits were reduced by 10 percent; (iii) 11.6 percent if the Project was to experience a commissioning delay of one year; and (iv) 8.4 percent if all (i), (ii), and (iii) happen. With only national environmental benefits, the EIRR will be reduced to 12.1 percent. Without environmental benefits, the EIRR would decrease to 11.8 percent. RMB depreciation of 30 percent will reduce EIRR to 10.6 percent.

4. The Project EIRR

142. The EIRR for the whole Project is 14.1 percent (Table A14.4). The sensitivity analysis showed the EIRR would decrease to (i) 12.4 percent if the Project were to experience a cost overrun of 10 percent; (ii) 12.0 percent if the energy sales were reduced by 10 percent; (iii) 12.1 percent if the Project was to experience a commissioning delay of one year; and (iv) 8.8 percent if all (i), (ii), and (iii) happen. With only national environmental benefits, the EIRR will be reduced to 12.5 percent. Without environmental benefits, the EIRR would decrease to 8.8 percent. With 10 percent reduction in avoided cost (benefits), the EIRR would go down to 12 percent. RMB depreciation of 30 percent will reduce EIRR to 10.8 percent.

C. Project Risk Analysis

143. To complement the above deterministic analysis, risk analyses have been performed using a probabilistic approach to the perceived risk factors that affect the viability of the Project. Four broad categories of risk have been considered:

(i) Demand Risk: Demand risks are related to lower peak-load demand growth than expected and/or breach of contract by the purchaser. A low peak-load growth and/or an important reduction in electricity off take could jeopardize the economic viability of the Project.

(ii) Price Risk: Price risk is related to the willingness and ability of consumers to pay for electricity and changes. Recent experience in the PRC shows that the power producer could also be confronted with unexpected price changes in both inputs and outputs.

(iii) Project Cost Risk: Higher-than-estimated project cost usually results from (a) higher equipment prices. The major equipment and facilities of generation will be purchased through international competitive bidding. Prices could, therefore, be affected by market fluctuations; (b) implementation delays. Implementation delays during construction period are a common phenomenon for many infrastructure projects. They are caused by a number of factors, in particular, delay of construction due to interfacing problems between different suppliers, unforeseen site conditions and inadequate construction management; and (c) exchange rate fluctuations. RMB Yuan depreciation would result in a major cost increase of the Project. Though RMB has been stable for a long time, there could be Yuan depreciation because of more stringer macroeconomic condition due to the Asia financial crisis.

(iv) Operating Performance Risk: Poor operational performance could be caused by low quality of generating equipment and facilities, and inadequate maintenance and poor management.

144. The risk analysis was carried out for EIRR to ensure the economic viability of the wind farms. Based on the foregoing considerations and sensitivity analyses, five variables of EIRR analysis have been selected as the crucial risk variables because of their significant impact on the project economic viability. The risk analysis was carried out using Monte Carlo simulation technique.[82] The inputs for the risk analysis are taken from the base case cost/benefit analysis. The correlation between risk variables is explicitly considered before the simulation to avoid generation of unrealistic project scenarios. The probability distributions attached to the selected variables are based on past Bank experience in power projects in general and the PRC in particular and extensive discussion with EA and relevant agencies in the PRC. Table A14.5 presents the selected variables including generation, plant capital cost, avoided power supply cost, implementation delay and depreciation on RMB Yuan, the assumed value ranges and the assumed probability distributions. The results were based on 3,000 simulations.

145. The expected EIRR for the Project (Table A14.5), based on the weighted average of all simulated combinations is 13.9 percent (with a standard deviation of 2.8 percent), about 0.2 percent lower than the base case value without consideration of project risks. The probability for the EIRR to be below the considered discount rate of 10 percent is 6.0 percent (Cumulative Distribution of EIRR in Table A14.5).

[82] The simulation was carried out using the Risk Master computer software. Monte Carlo simulation works by generating a series of random numbers following the distribution of probability of each risk variable. For each simulation, which represents a combination of different state of risk variables, EIRRs are calculated and recorded. The results of 3,000 simulations are averaged.

Table A14.1: Economic Internal Rate of Return for Fujin Wind Farm

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2016	2021	2022	NPV
Costs (Y million)	.														
Capital cost	0.0	29.5	143.5	38.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	150.0
O&M cost	0.0	0.0	1.9	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	12.6
Total	0.0	29.5	145.4	40.4	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	162.6
Benefits (Y million)	.														
Net electricity sales (GWh)	0.0	0.0	34.9	87.4	92.0	92.0	92.0	92.0	92.0	92.0	92.0	92.0	92.0	92.0	511.1
Generation benefit	0.0	0.0	13.6	34.1	35.9	35.9	35.9	35.9	35.9	35.9	35.9	35.9	35.9	35.9	199.3
Net Benefits (Y million)	0.0	-29.5	-131.8	-6.3	33.8	33.8	33.8	33.8	33.8	33.8	33.8	33.8	33.8	33.8	36.7
													EIRR		**16.0%**

GWh = gigawatt-hour; KWh = kilowatt-hour; MW = megawatt; NPV = net present value; O&M = operation and maintenance; SI = sensitivity indicator; SV = switching value.
Note.: (i) discount rate = 12 percent; (ii) standard conversion factor = 0.93.

Sensitivity Analysis of EIRR		**Change in Variable**	**NPV** (Y million)	**EIRR**	**SI**	**SV**
Base Case			35.8	16.0%		
(i)	Capital cost overrun	10%	20.9	14.1%	4.60	24.0
(ii)	Benefit reduction	-10%	16.1	13.8%	5.50	18.2
(iii)	Implementation delay	1 year	18.0	13.8%		
(iv)	Combination of (i), (ii), and (iii)		-18.4	10.3%		
(v)	With national environmental benefit		15.7	13.8%	5.61	17.8
(vi)	Without national and global benefitRMB (exchange rate) depreciation		-27.1	8.9%	17.57	5.7

(vii)				30%		4.6			12.4%		2.9			34.4	

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2016	2021	2022	NPV
Costs (Y million)	.														
Capital cost	0.0	32.5	143.5	35.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	150.5
O&M cost	0.0	0.0	1.9	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	12.6
Total	0.0	32.5	145.4	37.4	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	163.1
Benefits (Y million)	.														
Net electricity sales (GWh)	0.0	0.0	19.5	58.4	58.4	58.4	58.4	58.4	58.4	58.4	58.4	58.4	58.4	58.4	324.3
Generation benefit	0.0	0.0	11.6	28.9	30.4	30.4	30.4	30.4	30.4	30.4	30.4	30.4	30.4	30.4	169.1
Net Benefits (Y million)	0.0	-32.5	-133.8	-8.5	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3	6.0
													EIRR		**12.75 %**

GWh = gigawatt-hour; KWh = kilowatt-hour; MW = megawatt; NPV = net present value; O&M = operation and maintenance; SI = sensitivity indicator; SV = switching value.
Note.: (i) discount rate = 12 percent; (ii) standard conversion factor = 0.93.

Sensitivity Analysis of EIRR	**Change in Variable**	**NPV** (Y million)	**EIRR**	**SI**	**SV**
Base Case		6.00	12.7%		
(i) Capital cost overrun	10%	8.9	11.1%	24.8	4.0
(ii) Benefit reduction	-10%	-10.8	10.8%	28.0	3.6
(iii) Implementation delay	1 year	-11.9	10.8%		

(iv)	Combination of (i), (ii), and (iii)		-45.3	7.7%	
(v)	With national environmental benefit		-3.9	11.6%	16.5	6.1
(vi)	Without national and global benefit		-59.3	4.8%	108.8	0.9
(vii)	RMB (exchange rate) depreciation	30%	-25.3	9.6%	17.4	5.8

Table A14.3: Economic Internal Rate of Return for Dabancheng Wind Farm

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2016	2021	2022	NPV
Costs (Y million)	.														
Capital cost	0.0	35.6	184.1	38.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
O&M cost	0.0	0.0	2.3	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Total	0.0	35.6	186.4	40.9	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Benefits (Y million)	.														
Net electricity sales (GWh)	0.0	0.0	34	101.9	101.9	101.9	101.9	101.9	101.9	101.9	101.9	101.9	101.9	101.9	101.9
Generation benefit	0.0	0.0	14.8	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0
Net Benefits (Y million)	0.0	-35.6	-35.8	-3.8	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4
													EIRR		**13.6 %**

GWh = gigawatt-hour; KWh = kilowatt-hour; MW = megawatt; NPV = net present value; O&M = operation and maintenance; SI = sensitivity indicator; SV = switching value.

Note.: (i) discount rate = 12 percent; (ii) standard conversion factor = 0.93.

Sensitivity Analysis of EIRR	**Change in Variable**	**NPV** (Y million)	**EIRR**	**SI**	**SV**

Base Case			17.50	13.6%		
(i)	Capital cost overrun	10%	-0.7	11.9%	10.4	9.6
(ii)	Benefit reduction	-10%	-3.9	11.6%	12.2	8.2
(iii)	Implementation delay	1 year	-4.3	11.6%		
(iv)	Combination of (i), (ii), and (iii)		-46.1	8.4%	36.3	2.8
(v)	With national environmental benefit		-1.3	12.1%		
(vi)	Without national and global benefit		-2.6	11.8%	11.5	8.7
(vii)	RMB (exchange rate) depreciation	30%	-17.6	10.6%	6.7	15.0

Table A14.4: Economic Internal Rate of Return of Wind Power Project

		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2016	2021	2022	NPV
Costs (Y million)		.														
Fujin Wind Farm																
	Capital Cost	0.0	29.5	143.5	38.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	150.0
	O&M Cost	0.0	0.0	1.9	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	12.6
Xiwaizi Wind Farm																
	Capital Cost	0.0	32.5	143.5	35.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	150.5
	O&M Cost	0.0	0	1.9	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	12.6
Dabancheng Wind Farm																
	Capital Cost	0.0	35.6	184.1	38.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	183.8
	O&M Cost	0.0	0.0	2.3	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	15.4
	Total Cost	0.0	97.6	477.2	118.7	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	524.8
Benefits (Y million)																

Fujin Wind Farm	0.0	0.0	13.6	34.1	35.9	35.9	35.9	35.9	35.9	35.9	35.9	35.9	35.9	35.9		199.4	
Xiwaizi Wind Farm	0.0	0.0	11.6	28.9	30.4	30.4	30.4	30.4		30.4	30.4	30.4	30.4	30.4	30.4		168.9
Dabancheng Wind Farm	0.0	0.0	14.8	37.1	39.0	39.0	39.0	39.0		39.0	39.0	39.0	39.0	39.0	39.0		216.7
Total Benefit	0.0	0.0	40.0	100.1	105.3	105.3	105.3	105.3		105.3	105.3	105.3	105.3	105.3	105.3		585.0
Net Benefits (Y million)	0.0	-97.6	-437.2	-18.6	98.5	98.5	98.5	98.5		98.5	98.5	98.5	98.5	98.5	98.5		60.2
														EIRR			**14.1%**

GWh = gigawatt-hour; KWh = kilowatt-hour; MW = megawatt; NPV = net present value; O&M = operation and maintenance; SI = sensitivity indicator; SV = switching value.

Note.: (i) discount rate = 12 percent; (ii) standard conversion factor = 0.93.

Sensitivity Analysis of EIRR	**Change in Variable**	**NPV** (Y million)	**EIRR**	**SI**	**SV**
Base Case		59.3	14.1%		
(i) Capital cost overrun	10%	11.4	12.4%	8.08	12.4
(ii) Energy sales reduction	-10%	1.4	12.0%	9.76	10.2
(iii) Implementation delay	1 year	1.8	12.1%		
(iv) Combination of (i), (ii), and (iii)		-109.8	8.8%		
(v) Avoided cost decrease	-10%	1.4	12.0%	9.76	10.2
(vi) With national environmental benefit		13.1	12.5%	7.79	12.8
(vii) Without national and global benefit		-89.0	8.8%	25.01	4.0
(viii) RMB (exchange rate) depreciation	30%	-41.4	10.8%	5.7	17.7

ECONOMIC ANALYSIS OF ENVIRONMENTAL IMPACT

1. Introduction

146. The economic analysis of environmental impact requires an evaluation of avoided environmental costs of the Project, which are taken as environmental benefits/costs of the Project. In the least-cost analysis, two cases (with/without proposed wind farm) were studies to identify its environmental benefits (costs) on the selected power grids (HPG, LPG and XPG). The environmental impact analysis is carried out in four steps:

Step 1: major stressors or polluters are identified;
Step 2: impact screening is carried out for each stressor;
Step 3: if the impacts are major, effort is made to place monetary valuation; and
Step 4: the benefits (costs) flows are quantified for integration with the economic analysis of the Project.

B. Identification and Screening of Environmental Stressors

147. Air pollution emissions were mainly come from the coal-fired power plants in each power grids. Table A15.2 describes the average coal contents used in three power grids. Table A15.2 provides a summary of the emission of the major environmental stressors, including SO_2, NO_x, PM_{10} and CO_2.

148. In Step 2, these environmental stressors are screened for their potential impacts on four major groups: human health, human welfare, environmental resources, and global systems. This was shown in Table A15.3. Out of the various impacts, the following major impacts are significant and they are described as follows:

(i) **Human Health Impacts**: increased morbidity and mortality from conventional air emissions (PM_{10}, SO_2, and NO_x)

Fine Particulate Matter Formed by PM_{10}, NO_x, and SO_2 Emissions: Health studies currently focus on airborne particles that are small enough to be inhaled deeply into the lungs (called PM_{10}). PM_{10} aerosols resulting from the combustion of fossil fuels include sulfate and nitrate aerosols, acid aerosols, and other chemical constituents. Their impacts include both premature mortality and chronic acute respiratory disease.

(ii) **Human Welfare Impacts**: reduced visibility and materials damage from air emissions of PM_{10}, SO_2, and NO_x.

(iii) **Visibility Impacts**: Particulate matter (less than 2.5 micrometers in diameter) that is emitted directly from industries or is formed in the presence of sulfur dioxide and nitrogen oxide gas emissions can reduce visual range.

(iv) **Building and Materials Impacts**: Particulate matter and acid deposition from sulfur dioxide emissions can damage materials. Materials damage can include surface soiling, surface erosion, blistering, paint discoloration, corrosion and tarnishing of metals and electronic components, fading, reduction of fabric tensile strength, and spalling of buildings and monuments.

(vi) **Global Impact**: It is well recognized that environmental impacts are not confined to the immediate location or within country limits but involves impacts on the global level. The economic value of CO_2 was assessed using the Bank's Workbook estimates.

C. Economic Assessment of Environmental Impacts

149. Once the major environmental impacts and their influence on human health, human welfare and socioeconomic activities are properly identified, the next step is to value such impacts economically. In Step 3, environmental impact of the major environmental stressors will be evaluated in three ranges in terms of distances to the load center: local (within 30 kilometers [km]), regional (beyond 30 km and within 100 km), and distant (beyond 100 km and within 500 km). The information on population density and per capita gross domestic product (GDP) in each region are shown in Table A15.4.

150. There are various methods available for impact valuations and some of the methods require substantial amount of primary data, time and field investigations. Thus, benefit transfer method (BTM) was used for this assessment. The BTM allows using results from similar valuations conducted in the different parts of the world with proper adjustments to any particular Project. While adjusting the data from the results of original research in USA to the PRC (Table A15.5), three major adjustments were carried out for: (i) GDP differentials between USA and the PRC; (ii) updating price level to 1999 constant prices; and (iii) medical cost level differentials between USA and the PRC. For inflation adjustments, GDP deflator was used. Table A15.6 summarizes the adjusted values for environmental impacts. The period of environmental impact is assumed to be 22 years (from 2000 to 2022). The relevant GDP growth rate and population growth rates used in this analysis are summarized in Table A15.7.

151. In Step 4, for the economic valuation of environmental impacts, an average value was used. The environmental cost differences (avoid environmental cost) between the base case and the alternative case are taken as the environmental benefits of the Project. The results are listed in Table A15.8. There are other environmental impacts that were not estimated due to methodological difficulties or lack of data.

Table A15.1: Coal Quality Analysis

	Item	Unit	HPG	LPG	XPG
Industrial Analysis	Heat value	Kcal/kg	4,340	5,500	5,500
	Inherent moisture	%	na	na	na
	Ash content	%	26.7	20.0	17.2
Element Analysis	Carbon	%	63	63	65
	Hydrogen	%	na	na	na
	Oxygen	%	na	na	na
	Nitrogen	%	na	na	na
	Sulfur	%	0.3	1.0	0.9

Table A15.2: Environmental Stressors and Averaged Annual Emissions

(wind farm, kt/year)

	CO_2	SO_2	NO_x	PM_{10}
Fujin	95.3	0.29	0.28	0.08
Xiwaizi	52.1	0.47	0.22	0.05
Dabancheng	84.9	0.58	0.37	0.10

Table A15.3: Potential Impacts

B. Global

Stessors	**Human Health**		**Human Welfare**		**Environment**	**Resouces**		**System**
	Mortality	Morbidity	Materials	Resource Use	Social/ Cultural	Coastal Marine	Ground Water	Bio-Diversity	
PM_{10}	x	x	x	x	x				
SO_2	x	x	x	x	x				
NO_x	x	x	x						
CO_2									x

Table A15.4: Population Density and Per Capita GDP in Affected Areas (1999 prices)

		Heilongjiang			**Liaoning**			**Xinjiang**		
		Local	**Regional**	**Distant**	**Local**	**Regional**	**Distant**	**Local**	**Regional**	**Distant**
Population Density	People/kM2	505.8	81.0	279.0	705.8	279.0	279.0	111.4	51.1	10.2
Population	1,000 people	1,429	1,158	105,127	1,995	3,987	105,146	315	731	3,857
Per Capita GDP	Yuan/person	6,444.6	6,444.6	6,444.6	7,671.7	7,671.7	7,671.7	5,400.0	5,400.0	5,400.0

Table A15.5: Unit Value for Environmental Emissions in USA

($[1992]/1,000 mt/person)[a]

	Local		Regional		Distant	
	Low Limit	Upper Limit	Low Limit	Upper Limit	Low Limit	Upper Limit
PM_{10}	0.200	0.300	0.100	0.300	0.040	0.080
SO_2	0.040	0.080	0.020	0.040	0.010	0.020
NO_x	0.060	0.080	0.040	0.060	0.010	0.020

[a] Source: Economic Evaluation of Environmental Impacts – A Workbook, ADB, March, 1996.

Table A15.6: Adjusted Average Unit Value for Environmental Emissions
(Yuan [1999]/1,000 mt/person)

	Heilongjiang			Liaoning			Xinjiang		
	Local	Regional	Distant	Local	Regional	Distant	Local	Regional	Distant
PM_{10}	0.397	0.318	0.096	0.471	0.377	0.115	0.342	0.273	0.083
SO_2	0.095	0.048	0.024	0.113	0.057	0.029	0.082	0.041	0.021
NO_x	0.111	0.079	0.024	0.132	0.094	0.029	0.096	0.068	0.021

Table A15.7: GDP and Population Growth Rates (%)

	Heilongjiang		Liaoning		Xinjiang	
Period	Population	GDP	Population	GDP	Population	GDP
1999-2000	0.6	9.0	0.5	7.8	1.5	8.5
2001-2010	0.6	7.6	0.5	7.2	1.5	7.4
2011-2022	0.6	6.5	0.5	6.6	1.5	6.5

Table A15.8: Estimated Environmental Impact for EIRR Calculation

(Yuan million)

	Fujin			Xiwaizi			Dabancheng		
Year	Base (1)	Alternative (2)	Net Benefit (2-1)	Base (3)	Alternative (4)	Net Benefit (4-3)	Base (5)	Alternative (6)	Net Benefit (6-5)
2000	7,345.9	7,345.9	0.0	8,688.5	8,688.5	0.0	600.5	600.5	0.0
2001	7,861.7	7,861.7	0.0	10,573.2	10,573.2	0.0	643.3	643.3	0.0
2002	8,433.9	8,439.5	5.6	12,270.0	12,272.8	2.9	763.2	764.4	1.2
2003	8,749.1	8,764.7	15.5	13,836.4	13,846.1	9.8	829.5	832.9	3.7
2004	9,311.9	9,328.7	16.7	15,543.8	15,571.6	27.8	895.5	899.2	3.7
2005	10,126.1	10,133.7	7.6	17,376.0	17,384.1	8.1	952.6	956.3	3.7
2006	10,710.6	10,718.2	7.7	19,286.8	19,295.6	8.9	981.5	984.9	3.4
2007	11,429.3	11,437.2	7.9	20,531.4	20,540.8	9.3	1,033.8	1,037.4	3.6
2008	12,148.1	12,156.2	8.1	21,776.1	21,785.9	9.8	1,086.2	1,089.8	3.7
2009	12,935.0	12,943.3	8.3	22,840.0	22,850.0	10.0	1,129.6	1,133.3	3.7
2010	13,721.9	13,730.4	8.5	23,903.9	23,914.2	10.3	1,173.0	1,176.7	3.7
2011	14,508.8	14,517.5	8.7	24,967.8	24,978.3	10.6	1,216.4	1,220.2	3.8
2012	15,585.0	15,594.8	9.8	26,003.5	26,014.2	10.7	1,301.7	1,305.3	3.7
2013	16,661.2	16,672.1	10.9	27,039.2	27,050.0	10.8	1,386.9	1,390.5	3.6
2014	17,737.3	17,749.4	12.0	28,075.0	28,085.9	10.9	1,472.1	1,475.6	3.5
2015	18,813.5	18,826.7	13.1	29,110.7	29,121.7	11.0	1,557.3	1,560.7	3.4
2016	19,889.7	19,903.9	14.3	30,146.4	30,157.5	11.1	1,642.5	1,645.9	3.3
2017	21,251.8	21,265.8	13.9	31,224.9	31,236.2	11.3	1,740.8	1,744.2	3.4
2018	22,614.0	22,627.6	13.6	32,303.4	32,314.8	11.4	1,839.1	1,842.5	3.4
2019	23,976.1	23,989.4	13.3	33,381.9	33,393.4	11.5	1,937.4	1,940.9	3.4
2020	25,338.2	25,351.2	13.0	34,460.3	34,472.0	11.7	2,035.7	2,039.2	3.5
2021	26,700.4	26,713.0	12.6	35,538.8	35,550.6	11.8	2,134.1	2,137.6	3.5
2022	26,700.4	26,713.0	12.6	35,538.8	35,550.6	11.8	2,134.1	2,137.6	3.5

NPV 1999	**91,062.6**	**91,125.5**	**63.0**	**142,621.2**	**142,686.5**	**65.3**	**7,883.6**	**7,903.7**	**20.1**

EIRR = economic internal rate of return.

Note: discount rate = 12 percent.

Table A15.9: Estimated Environmental Impact for Fujin Wind Farm

(Y million)

Year	Externality Cost of Base Case			Externality Cost of Alternative Case			Net Benefit	
	National	Global	Subtotal	National	Global	Subtotal	National	National + Global
2000	5,647.7	1,698.1	7,345.9	5,647.7	1,698.1	7,345.9	0.0	0.0
2001	6,074.4	1,787.3	7,861.7	6,074.4	1,787.3	7,861.7	0.0	0.0
2002	6,415.4	2,018.5	8,433.9	6,419.6	2,019.9	8,439.5	4.2	5.6
2003	6,677.9	2,071.2	8,749.1	6,689.4	2,075.2	8,764.7	11.5	15.5
2004	7,172.3	2,139.6	9,311.9	7,185.0	2,143.6	9,328.7	12.7	16.7
2005	7,896.2	2,229.9	10,126.1	7,900.4	2,233.3	10,133.7	4.2	7.6
2006	8,402.4	2,308.2	10,710.6	8,406.7	2,311.6	10,718.2	4.3	7.7
2007	9,061.5	2,367.8	11,429.3	9,065.9	2,371.3	11,437.2	4.4	7.9
2008	9,720.6	2,427.5	12,148.1	9,725.2	2,431.0	12,156.2	4.6	8.1
2009	10,434.2	2,500.8	12,935.0	10,439.0	2,504.3	12,943.3	4.8	8.3
2010	11,147.8	2,574.2	13,721.9	11,152.8	2,577.6	13,730.4	5.0	8.5
2011	11,861.4	2,647.5	14,508.8	11,866.6	2,650.9	14,517.5	5.2	8.7
2012	12,841.3	2,743.6	15,585.0	12,847.7	2,747.1	15,594.8	6.3	9.8
2013	13,821.3	2,839.8	16,661.2	13,828.8	2,843.3	16,672.1	7.4	10.9
2014	14,801.3	2,936.0	17,737.3	14,809.9	2,939.5	17,749.4	8.5	12.0

2015	15,781.3	3,032.2	18,813.5	15,790.9	3,035.7	18,826.7	9.6	13.1
2016	16,761.3	3,128.4	19,889.7	16,772.0	3,131.9	19,903.9	10.7	14.3
2017	18,041.7	3,210.1	21,251.8	18,052.1	3,213.6	21,265.8	10.4	13.9
2018	19,322.2	3,291.8	22,614.0	19,332.2	3,295.4	22,627.6	10.0	13.6
2019	20,602.6	3,373.5	23,976.1	20,612.3	3,377.1	23,989.4	9.7	13.3
2020	21,883.0	3,455.2	25,338.2	21,892.4	3,458.8	25,351.2	9.4	13.0
2021	23,163.4	3,537.0	26,700.4	23,172.5	3,540.5	26,713.0	9.0	12.6
2022	23,163.4	3,537.0	26,700.4	23,172.5	3,540.5	26,713.0	9.0	12.6
NPV								
1999	**73,205.2**	**17,857.4**	**91,062.6**	**73,248.0**	**17,877.5**	**91,125.5**	**42.8**	**63.0**

Note: discount rate = 12 percent.

Table A15.10: Estimated Environmental Impact for Xiwaizi Wind Farm

(Y million)

Year	Externality Cost of Base Case			Externality Cost of Alternative Case			Net Benefit	
	National	Global	Subtotal	National	Global	Subtotal	National	National + Global
2000	6,736.6	1,951.9	8,688.5	6,736.6	1,951.9	8,688.5	0.0	0.0
2001	8,571.4	2,001.7	10,573.2	8,571.4	2,001.7	10,573.2	0.0	0.0
2002	10,028.4	2,241.6	12,270.0	10,030.7	2,242.1	12,272.8	2.3	2.9
2003	11,545.1	2,291.3	13,836.4	11,553.2	2,292.9	13,846.1	8.1	9.7
2004	13,212.4	2,331.4	15,543.8	13,238.1	2,333.5	15,571.6	25.8	27.8
2005	14,976.8	2,399.3	17,376.0	14,983.2	2,401.0	17,384.1	6.4	8.1
2006	16,815.3	2,471.5	19,286.8	16,822.4	2,473.2	19,295.6	7.1	8.9

2007	17,983.6	2,547.9	20,531.4	17,991.2	2,549.6	20,540.8	7.6	9.3
2008	19,151.9	2,624.2	21,776.1	19,159.9	2,626.0	21,785.9	8.0	9.8
2009	20,122.5	2,717.5	22,840.0	20,130.8	2,719.2	22,850.0	8.3	10.0
2010	21,093.2	2,810.7	23,903.9	21,101.7	2,812.4	23,914.2	8.5	10.3
2011	22,063.8	2,903.9	24,967.8	22,072.7	2,905.7	24,978.3	8.8	10.5
2012	22,972.2	3,031.3	26,003.5	22,981.1	3,033.1	26,014.2	8.9	10.7
2013	23,880.6	3,158.7	27,039.2	23,889.6	3,160.4	27,050.0	9.0	10.8
2014	24,788.9	3,286.0	28,075.0	24,798.0	3,287.8	28,085.9	9.1	10.9
2015	25,697.3	3,413.4	29,110.7	25,706.5	3,415.2	29,121.7	9.2	11.0
2016	26,605.7	3,540.8	30,146.4	26,615.0	3,542.6	30,157.5	9.3	11.1
2017	27,570.3	3,654.6	31,224.9	27,579.7	3,656.4	31,236.2	9.5	11.3
2018	28,534.9	3,768.5	32,303.4	28,544.5	3,770.3	32,314.8	9.6	11.4
2019	29,499.5	3,882.4	33,381.9	29,509.2	3,884.2	33,393.4	9.7	11.5
2020	30,464.1	3,996.3	34,460.3	30,473.9	3,998.1	34,472.0	9.9	11.7
2021	31,428.7	4,110.2	35,538.8	31,438.7	4,112.0	35,550.6	10.0	11.8
2022	31,428.7	4,110.2	35,538.8	31,438.7	4,112.0	35,550.6	10.0	11.8
NPV 1999	**122,829.0**	**19,792.2**	**142,621.2**	**122,884.5**	**19,802.0**	**142,686.5**	**55.5**	**65.3**

Note: discount rate = 12 percent.

Table A15.11: Estimated Environmental Impact for Dabancheng Wind Farm

(Y million)

Year	Externality Cost of Base Case			Externality Cost of Alternative Case			Net Benefit	
	National	Global	Subtotal	National	Global	Subtotal	National	National + Global

2000	95.9	504.6	600.5	95.9	504.6	600.5	0.0	0.0
2001	125.5	517.8	643.3	125.5	517.8	643.3	0.0	0.0
2002	152.8	610.4	763.2	153.1	611.4	764.4	0.2	1.2
2003	184.0	645.3	829.3	184.8	648.2	832.9	0.8	3.7
2004	213.3	682.2	895.5	214.2	685.0	899.2	0.9	3.7
2005	236.9	715.7	952.6	237.8	718.6	956.3	0.9	3.7
2006	261.2	720.3	981.5	261.7	723.2	984.9	0.6	3.4
2007	274.6	759.3	1,033.8	275.1	762.2	1,037.4	0.6	3.6
2008	288.0	798.2	1,086.2	288.6	801.3	1,089.8	0.6	3.7
2009	296.1	833.5	1,129.6	296.7	836.6	1,133.3	0.6	3.7
2010	304.2	868.8	1,173.0	304.9	871.8	1,176.7	0.7	3.7
2011	312.4	904.1	1,216.4	313.1	907.1	1,220.2	0.7	3.8
2012	330.5	971.2	1,301.7	331.2	974.2	1,305.3	0.7	3.7
2013	348.6	1,038.3	1,386.9	349.3	1,041.2	1,390.5	0.6	3.6
2014	366.7	1,105.4	1,472.1	367.4	1,108.2	1,475.6	0.6	3.5
2015	384.9	1,172.5	1,557.3	385.4	1,175.3	1,560.7	0.6	3.4
2016	403.0	1,239.6	1,642.5	403.5	1,242.3	1,645.9	0.6	3.3
2017	426.7	1,314.1	1,740.8	427.3	1,316.9	1,744.2	0.6	3.4
2018	450.4	1,388.7	1,839.1	451.0	1,391.5	1,842.5	0.6	3.4
2019	474.1	1,463.3	1,937.4	474.8	1,466.1	1,940.9	0.6	3.4
2020	497.8	1,537.9	2,035.7	498.5	1,540.7	2,039.2	0.6	3.5
2021	521.6	1,612.5	2,134.1	522.2	1,615.3	2,137.6	0.7	3.5
2022	521.6	1,612.5	2,134.1	522.2	1,615.3	2,137.6	0.7	3.5
NPV								
1999	**1,868.4**	**6,015.2**	**7,883.6**	**1,872.2**	**6,031.5**	**7,903.7**	**3.8**	**20.1**

Note: discount rate = 12 percent.

INCREMENTAL COST

A. Broad Development Goals

152. The overall development objective of the Project is the provision or supply of sufficient electricity and energy to meet national development needs at the lowest possible cost. Without GEF intervention, meeting this goal will require increased use of coal-fired power plants.

B. Baseline

153. The baseline consists of what the Government would do without GEF support. Under the baseline, a number of barriers exist to the large-scale grid-connected wind power development in the PRC. Without these barriers being removed through the Project, wind power market will remain undeveloped. The share of wind power in the national power mix is likely to remain negligible. Although the Government plans to launch aggressive programs to increase the use of alternative energy to replace coal and improve energy efficiency, coal is still likely to continue to provide two thirds of the PRC's commercial energy in 2020. This corresponds to a three-fold increase in coal consumption by the year 2020, and leads to a tripled GHG emission by 2020. The US Energy Information Administration (EIA) projected that China will become the world's largest carbon emitter before the year 2020.

C. Global Environment Objectives

154. The global environmental objective of the Project is the reduction of GHG emissions by removing the major barriers to the development of wind power to replace fossil fuel use in thee PRC. The Project has been designed to be consistent with GEF Operational Program #6 on "Promoting the Adoption of Renewable Energy by Removing Barriers and Reducing Implementation Costs".

D. GEF Alternative

155. Wind resource assessment studies have indicated that the PRC has a potential of 250 GW of power capacity from wind. Although the Government has made aggressive efforts and placed a high priority to promote wind power development, the barriers that exist, prevent the PRC's enormous potential from being realized. Without the barriers being removed through the Project, however, a widespread national program of replication of wind power is unlikely to take place. GEF support will play a catalyzing role to help the PRC to tap its enormous potential.

156. Activity 1 is designed to decrease wind power tariffs. This activity will develop a standard financial evaluation method specifically for calculating wind power tariffs, and estimate an appropriate wind power tariff benchmark level as an upper limit for wind power pricing approval. It will also improve the incentive regulations that clearly spell out the financing schemes and develop a mechanism for full compensation of the electricity distributors of the price difference between the wind-based electricity and the grid average price. It will hold wide consultations with key stakeholders to reach an agreement. Finally, this activity will provide training at the provincial level in the standard financial evaluation method for wind power tariff and implementation of standard power purchase agreement. This activity is targeted to remove the financial barriers (Barrier No. 2 and 4), thereby making wind power more competitive and attractive. GEF will contribute US$750,000 to support this activity. This is an activity entirely focused on removing barriers and building capacity, which would not take place without this project.

157. Activity 2 is intended to develop a competitive institutional model for development of wind-based power generation projects. It will identify options for private sector involvement in the three wind farms under the Project and provide technical assistance in restructuring of existing wind power companies at Dabancheng, in the Xinjiang Autonomous Region. This activity aims to introduce competition in the development wind-based power generation facilities thereby decreasing wind-based electricity costs in the PRC. It is designed to remove the economic and institutional Barriers 2 and 3.

158. Activity 3 will assist the three provinces under the Project—the Xinjiang Autonomous Region and Liaoning and Heilongjiang provinces—in formulating and implementing market-oriented renewable energy policies, within the national renewable energy policy framework. It will assist in developing provincial wind power development plans; identifying options for development of provincial market-oriented wind power policies; developing RPS targets and implementation plans for wind power in the three provinces; and in conducting feasibility studies for green certificate trading. This activity is designed to directly remove the Barrier 5 and facilitate future replication of wind power in the PRC.

159. Activity 4 will involve conducting wind measurements at 25 promising sites in six selected provinces, transfer wind measurement data into the national wind resource database, as well as develop competitive bidding procedures for potential wind farm developers who may be interested to invest at these potential wind sites. This activity is designed to provide reliable site-specific wind resource information to the potential investors, hence reducing the transaction costs for potential wind developers and facilitating future investment in wind power. This will directly remove the information barrier (vi). This activity is also targeted to promote economies of scale with regard to development of new wind farms and introduce competition among potential wind farm developers. It is expected to create a larger and firmer market for wind turbine manufactures and promote technology transfer and the development of a domestic wind turbine manufacturing industry, thereby reducing the costs of wind-based power generation and removing the Barriers 1 and 2. This activity is crucial to remove both the information and economic barriers and facilitate future replication of wind power projects in the PRC.

160. Activity 5 will strengthen the evaluation capabilities of provincial decision-makers and increase their awareness and support with regard to wind power development. It will also strengthen the business development and management skills of staff of the wind farm companies.

161. Activity 6 will promote and disseminate at the national level the experience and lessons learned from the previous activities. This will further remove the information barrier and facilitate the larger replication of wind power development nationwide.

162. Activity 7 includes the provision of a GEF contingent grant to the respective provincial power companies, which will act as Executing Agency for the construction of the concerned wind, farm. Use of the contingent grant will reduce the incremental financial risks associated with the construction and operation of the wind farms under the Project. As the three wind farms will be of the first large-scale grid-connected commercial wind farms in the PRC financed from ADB's ordinary capital resources at normal interest rates, they are perceived of as being riskier than equivalent fossil-fuel power plants. In particular, they are considered riskier with regard to the completion risk of the wind farms and the marketing risk of the produced wind-based electricity, i.e., their financial viability is more sensitive to delays in construction and sale of lower than envisaged quantities of electricity than is the case for fossil-fuel power plants. Also,

under the Project options will be evaluated for increasing private sector participation in the wind farms in the future and the inclusion of a contingent grant in the financing arrangements for the wind farms is expected to promote the interest of the private sector in such participation.

E. Incremental Cost Matrix

163. The total Project costs, including capital investments in the three wind farms, amount to a total of $98.7 million. GEF will contribute a total of $12 million; ADB financing is $58.0 million with an equity contribution by the provincial power companies of $18.5 million equivalent and loans from domestic banks of $10.2 million equivalent. The incremental cost matrix is attached.

C. INCREMENTAL COST MATRIX

Activity	Baseline	Alternative	Increment
Activity 1. Improve wind power tariff structure	There is a wide variation in wind power tariff in the PRC, because there is no standard financial evaluation method to calculate wind power tariff. In addition, wind power tariff is too high in the PRC, making wind power less competitive in the market.	A standard and transparent financial evaluation method will be available. A wind power tariff benchmark will be set up as an upper limit. The three provinces will have the capacity to implement the standard financial model and PPAs.	Wind power tariff will be lower. Estimating wind power tariff has to follow a standard approach. Wind farms with high wind power tariff will not be approved. Wind power will become more competitive in the market. People's misconception of wind power being too expensive will be corrected. The standard financial evaluation method and PPAs will be implemented smoothly at the provincial level.
	The provincial power companies do not incentives to develop or purchase wind power because they have to share at least part of the price difference between the wind power price and grid average price. Cost: 0	A mechanism will be developed for full compensation of the power distributors of the price difference between the wind-based electricity and the grid average price. The price difference will be allowed to fully pass on to consumers. Cost: US$750,000	The price difference will not become a big burden to the provincial power companies. The utilities will have increased incentives to develop or purchase the wind power competitively. Cost: US$750,000 (GEF)

Activity	Baseline	Alternative	Increment
Activity 2. Develop competitive institutional models	The three wind farms to be financed under the Project will continue to be either utility-owned or utility as a major shareholder. The utility monopoly will remain to exist. There will be no competition and private sector involvement in the three wind farms. The operation efficiency of wind farm companies will continue to be low. Wind power cost and tariff will remain to be higher than it should be. Cost: .0	Recommendations on introducing competitive institutional model and private sector involvement will be proposed. The wind power companies in Dabancheng wind site will be restructured. Cost: US$550,000	The three wind farms will demonstrate a competitive institutional model for wind project development. Competition will be introduced. Non-government funds will be attracted. The utility monopoly will be broken. The operation efficiency of the wind farms will be improved. The wind power cost and tariff will be substantially reduced. Wind power will become more competitive in the market. Cost: US$550,000 (GEF)
Activity 3. Implement market-oriented wind power policy at provincial level	There will be no wind power planning at the provincial level. There will be no provincial wind power policy and implementation action plans for national renewable energy policy framework. There will be limited market mechanisms to promote wind power in China. There will be no provincial RPS target and implementation plans for RPS and green credit trading. Wind power market remains undeveloped. Cost: 0	The three provinces will have wind power planning. The three provinces will have a market-oriented wind power policy within the national renewable energy policy framework. The three provinces will have a RPS target and implementation plan. The three provinces will have the information and capacity for green credit trading. Cost: US$1,200,000	The three provinces will serve as pilot models for provincial wind power planning, provincial market mechanisms to promote wind power, and implementation of RPS and green credit trading. Wind power market will be fully developed in the three provinces. Cost: US$1,200,000 (GEF)

A. Activity	Baseline	Alternative	Increment
Activity 3. Implement market-oriented wind power policy at provincial level	There will be no wind power planning at the provincial level. There will be no provincial wind power policy and implementation action plans for national renewable energy policy framework. There will be limited market mechanisms to promote wind power in China. There will be no provincial RPS target and implementation plans for RPS and green credit trading. Wind power market remains undeveloped. Cost: 0	The three provinces will have wind power planning. The three provinces will have a market-oriented wind power policy within the national renewable energy policy framework. The three provinces will have a RPS target and implementation plan. The three provinces will have the information and capacity for green credit trading. Cost: US$1,200,000	The three provinces will serve as pilot models for provincial wind power planning, provincial market mechanisms to promote wind power, and implementation of RPS and green credit trading. Wind power market will be fully developed in the three provinces. Cost: US$1,200,000 (GEF)
Activity 4: Conduct wind resource measurement	The information on wind resource data will remain inadequate and unreliable. The potential investors will continue to be inaccessible to wind resource data. Domestic wind manufacturing industry will remain undeveloped because of the small market. Cost: 0	Professional and reliable wind measurement will be conducted at 25 promising sites. Wind measurement data will be made available for the potential investors. Competitive bidding will be conducted at these promising sites. Cost: US$1,900,000	High-quality site-specific wind measurement data will be available for potential investors. Investment in wind farms is expected to increase. Transaction costs for wind developers are reduced. An economy of scale is reached to promote domestic manufacture industry. Wind power cost will be lower. Competitive market will be formed. Cost: US$1,900,000 (GEF)

Activity 5: Build capacity at provincial levels	The provincial decision-makers will continue to have low awareness of wind power. It is difficult to implement wind power policies at provincial level. The operation efficiency of wind power companies will remain low. Cost: 0	The provincial decision-makers will have increased awareness and information of wind power. The wind power companies will have improved business management skills. Cost: US$650,000	The provincial decision-makers will have increased support to wind power development. The operation efficiency of wind power companies will improve. Wind power cost will be reduced. Cost: US$650,000 (GEF)
B. Activity	**Baseline**	**Alternative**	**Increment**
Activity 6: Promote provincial experience to the nation	The information on the three provinces will not be disseminated. The three provinces will not serve as a model across the nation. The replication of wind farms will not occur at the national level. Cost: 0	The experience and lessons learned in the three provinces will be promoted and disseminated across the nation. Cost: US$350,000	The three provinces will serve as pilot models for other provinces to develop wind power. A large-scale replication of wind power development will occur at the national level. Cost: US$350,000 (GEF)
Activity 7: Finance three wind farms	Because the three wind farms are one of the first large-scale grid-connected commercial wind farms in the country, the project investors are undertaking a high risk. Cost: US$86,700,000	GEF supports up to 10 percent of the ADB loans as contingent grant to help reduce the risks associated with the ADB loans. As a result, the pilot projects can move ahead. Cost: US$92,700,000	The pilot wind farms will demonstrate both technical and commercial viability as well as the competitive project development model for wind projects in the PRC and elsewhere. The contingent grant will be repaid back to GEF after 10 years operation if the wind farms are successful. Cost: US$6,000,000 (GEF) (repayment due after 10 years)
Global Environment Benefits	Wind power remains undeveloped. Barriers prevent widespread deployment of wind power.	Wind power is widely replicated. Economic, financial, information, and institutional barriers removed.	Significant GHG emissions are attained.

	Baseline carbon emissions of 60,000 tons of carbon/year from an equivalent coal-fired power plant of the three wind farms, and 200 million tons of carbon/year from the equivalent coal consumption of the total 250 GW wind potential.	Assuming 100 percent of the wind power will replace fossil fuels, alternative carbon emission = 0 tons of carbon per year.	Direct carbon emission reduction of 60,000 tons for the three wind farms within the project lifetime, and up to 200 million tons of carbon per year possible for the total 250 GW wind potential beyond project lifetime.
Domestic Benefits	Local and regional air pollution from coal burning is getting worse.	Local and regional air pollution will be reduced. Wind power business grows.	Public health impacts will improve from better air quality. Acid rain will be mitigated.
C. Activity	**Baseline**	**Alternative**	**Increment**
Costs	Total Baseline Costs: **ADB:** US$58,000,000 **Domestic equity:** US$18,500,000 **Domestic banks:** US$10,200,000	Total Project Costs: US$98,700,000	Total Incremental Costs: US$12,000,000 (GEF)

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ENERGY AND RESOURCES GROUP
310 BARROWS HALL
UNIVERSITY OF CALIFORNIA
BERKELEY, CA 94720-3050
FAX: (510) 642-1085
ERG: *http://socrates.berkeley.edu/erg*

DANIEL M. KAMMEN
ASSOCIATE PROFESSOR OF ENERGY AND SOCIETY
DIRECTOR,
RENEWABLE AND APPROPRIATE ENERGY LABORATORY
OFFICE TEL: (510) 642-1139
EMAIL: dkammen@socrates.berkeley.edu
RAEL: *http://socrates.berkeley.edu/~rael*
RAEL TEL & FAX: (510) 643-2243

June 25, 2000

Note: for questions regarding this document that require a response between June 26 and June 29, the author will be in Ethiopia. The author may not have access to email, and phone and fax correspondence is best. I am staying in the Ghion Hotel, Addis Ababa,

Tel: +251-1-51-32-22
Fax: +251-1-51-02-78.

From June 29 to July 4 I will be in remote locations in Kenya and not readily reached. After July 4 I will be at my Berkeley, California addresse, above.

Review and Evaluation of

Asian Development Bank (RSC No. C00327)
Wind Power Development Project in the People's Republic of China (PRC)

Project Summary and Evaluation Overview:

This project takes a commendable and important role in both addressing the pressing need for institutional change to open opportunities for new energy options, and demonstrating the technical (and ideally economic) benefits of wind-energy installations through a significant but limited set of demonstration sites (3 wind farms, totaling 78 MW). Experience in the PRC and elsewhere indicates that only after the *actua*l demonstration of the technical and economic viability of renewable energy projects will local energy planners take large-scale use of non-fossil fuel options seriously. This project also directly addresses the major hurdle to new, clean, energy initiatives: institutional barriers. The focus of this project on the needed reforms in the power sector – notably the introduction and adherence to a renewable energy portfolio standard -- is particularly critical. To motivate larger-scale change in the power sector, added measures are needed, however, to ensure that renewable energy systems will be considered seriously for new power projects when multinational development funds are not involved.

The explicit inclusion of environmental, health, and social benefits (in a framework that is currently partially montized, and could be increased, as is discussed in this review) is particularly well done. The methodological tools used for the analysis (notably the Benefit Transfer Method) are well executed, and should be made available to other economic development organizations.

The importance of developing a 'pipeline' of renewable energy projects, both in the PRC and beyond, is one of the most important aspects of this proposal. The recent improvements in technical aspects of RETs (renewable energy technologies), economic performance, infrastructure and managerial skill, and policy tools needed to establish RETs in markets previously dominated by traditional and fossil-fuel sources. The need to 'level the playing field' and support a diversity of energy options requires clear leadership to implement RETs in not only off-grid situations, but as key components of national and regional base and peak-load energy resources. High-profile ADB support for both individual RET projects, and, logically, a larger capacity for analysis, planning, and follow-up support of energy projects where RET options are taken seriously can dramatically increase the use of renewables both in Asia and worldwide[83].

There are several aspects of this new commitment to renewables that deserve special attention by the ADB and collaborating institutions:

- Analysis of the role of market transformation opportunities through the support of renewable energy options in cases where ADB funds could improve the future market through volume-based price decreases. Analysis of a number of market transformation initiatives has demonstrated the potential for significant regional and global improvements in the prices in renewable energy and energy efficiency systems (Duke and Kammen, 1999).

- Analysis of renewable energy projects not in isolation, but as integrated packages of solar, wind, and biomass systems together, or with low-carbon fossil-fuels (primarily gas) in combinations that build electricity reliability even with large percentages of intermittent energy in the power mix.

- Building of renewable energy infrastructure that is both technical, and managerial within the international energy and development organizations, and within the commercial sectors of many nations.

Each of these initiatives will be particularly critical in supporting the 2020 Energy Sector Strategy that calls for significant decreases in carbon intensity in the Chinese economy.

Finally, the PRC has the capacity to manufacture high quality and large quantities of solar, wind, biomass, and fuel-cell systems for domestic and international markets. An ADB focus on the PRC renewable energy market is thus all the more significant.

The opportunity to expand the range of technical and policy based renewable energy systems implemented in the PRC is particularly important to efforts to address global warming, providing a further important justification for this project.

General Comments:

[83]One option is a directorate for clean energy production on par with that for the expansion of fossil-fuel based projects.

The degree of pre-feasibility analysis, and commercial financial involvement in the wind farms is impressive.

The range of factors considered in the overall projects impact evaluation – notably the inclusion of a section in Appendix 15 on local air quality and human welfare including the PM_{10}, SO_x and NO_x analysis – is impressive. The use of the Benefit Transfer Method (BTM, Appendix 15, page 2ff) is well done, and should be widely disseminated and used as a model for renewable energy project cost/benefit analysis throughout the World Bank, the regional development banks, and national development plans. The importance of the method is not its conceptual framework, but the fact that the collection of the air quality numbers, the health standards measures, and the local/regional/distant framework can be distributed as spreadsheets for easy replication. It is important that these tools enter far wider circulation, otherwise cost/benefit, and net cost per ton of carbon calculations performed to evaluate renewable energy options will remain biased toward inaccurately high values (i.e., perpetuating the bias against renewable energy options, as is noted in the Main Report, page 3, paragraph 6).

While the Benefit Transfer Method used in Appendix 15 is exceedingly well done, recent advances in epidemiology permit a more straightforward and arguably accurate method. With the availability of exposure-response data on particulates, both at low (0 – 200 $\mu g/m^3$ - Dockery*, et al*., 1989; Pope, *et al.,* 1991) and high doses (200 – 6,000 $\mu g/m^3$ - Ezzati*, et al.*, 2000; Ezzati and Kammen, 2000) are more complete impact assessment can be done. This dose-response data can be used on its own, or combined with that on hospitalization based on particulate exposure from five Chinese cities (Xu, *et al*, 1998). These data can be used to develop an economic cost/benefit assessment of reductions in particulate pollutant emissions, which would result from this wind energy project or any other low on non-particulate producing power project. The Law on the Prevention of Air Pollution (c.f. Main Report, page 9, paragraph 16) could be used to implement this study and to utilize the results in least-cost air pollution reduction measures.

Even without the details of this calculation, the benefits will clearly be large, particularly in highly-populated areas of China. The cost-effectiveness of health improvements resulting from reduced local and regional air pollution is significant, estimated to be between US$ 10 – $50/DALY (Disability Adjusted Life Year). This puts the introduction of wind-generated electricity in areas with nearly population centers at a significant health and economic advantage.

The incremental cost calculation (Appendix 16) is incomplete. At the same time, it should be recognized that providing a realistic analysis will be particularly difficult due to the goal of this project to target and address institutional changes that are needed in the PRC to expand the types of situations where renewable are considered as serious options. Economic analysis of the success of the project to reduce the non-market barriers to the installation of RETs will be, to say the least, challenging. It would be worthwhile as a planning exercise and as an indication of the scope of renewable energy opportunities in the PRC and in Asia generally, to undertake life-cycle cost analysis of the potential for institutional changes resulting from this project to expand the RET market. It would be worthwhile to commission such a document.

The emphasis on implementing a renewable energy portfolio standard (RPS) is important, if not central, to the reforms proposed in this project. As written, however, the project could propose greater measures to make the introduction of the (proposed) 5% RPS a reality (e.g. Main Document, paragraph 48, and mentioned again but far too vaguely in item iii, page 37). Thus,

after noting that the adoption of the RPS is deemed central to this loan, no measure are taken to tie the loan directly to progress in that area. This need not be constructed as an impediment to the project, but as an area where the ADB can facilitate the analysis, evaluation, and implementation of best practices from international experience. Many economists, energy planners, and other experts – including the author – consider that the RPS will work in a particularly cost-effective fashion if it is not instituted only as a mandated target. A combination of green credits and pollution permits can be used to value clean energy generation at a level that is a more accurate measure of its true combined economic, social, and environmental benefit. Thus, coupling the RPS with trading schemes would further reduce the long-term costs of this project.

Development of a significant standing capacity for RET analysis and promotion within the ADB would also help the government of the PRC in its anticorruption campaign (Main Report, Section 5, page 48ff). Greater resources within the ADB devoted to the financial analysis of these projects will provide additional checks on proper use of project funds, and will provide added means of independent support for the development of new private-sector clean power producers that are one of the intended outcomes of this project.

This project addresses some of the important institutional issues that limit the introduction and cost-effectiveness of RETs in China. The funding break-down detailed in Appendix 16 does not appear to provide much direct support for the PRC to analyze, enact, and monitor these changes at administrative levels. Evaluation and enactment of changes in market structure may in many cases be improved by conferences, training sessions outside China, and relatively long-term training courses within China as well as visits by external experts. Added funding is needed to support these activities.

Specific Comments:

Project Brief, and Main Report (page 49, paragraph 79ff) and Recommendation documents:
Although it is not entirely clear from the project documents, it appears that the Ministry of Finance will be the source of primary project operational management. While multi-agency management is notoriously difficult, a broader range of technical and economic oversight is likely to result in superior project implementation, and broader dissemination of the project lessons of widespread applicability of renewable energy options. The roles of the SDPC, SETC, MOST, and the Chinese EPA and court system (that will both need to be involved through the Law of the Prevention of Air Pollution initially, and likely in time should Pollution Permits and Green Credits be applied [Main Report, pages 10 – 12]).

The entries (and page numbers) in the Table of Contents does not match all the sections in the Main Report.

Project Summary, page iv, and Main Report, Section V:
The current financial structure of the loan (20 year repayment, 3 year grace period) could be improved. One innovation, that would enhance the pressure for solid economic performance by the wind-farms, would be to tie the loan repayment to power production. While likely to be controversial, several avenues to do this exist, and each of these initiatives is consistent with the PRC's stated plans for power sector reform, decentralization, and increased true-cost pricing (Main Report, page 19ff).

The levelized costs from the Dabancheng (Y0.36/kWh), Fujin (Y0.33/kWh), and Xiwaizi (Y0.51/kWh) wind farms could be used as a basis of a repayment rate scheme tied to the actual rates. Greater length of the grace period, or discounts from the ADB interest rate can be

granted in response to better economic performance from the wind farms. This would encourage both the PRC and the ADB to collaborate on efforts to keep project costs low, and to emphasize maximizing the sustained power production from the new wind farm facilities.

Wind, solar, and biomass technologies have the benefit that they can be installed at many scales (in term of MW) with little or no penalty for particularly large or small systems. The technical and managerial experience gained at the Dabancheng, Fujin, and Xiwaizi wind farms can be applied to wind energy projects from single turbines, to those of many tens of MW. Thus, experience gained at these facilities, if disseminated, can lead to additional renewable energy projects of many sizes. Already the PRC has taken a global leadership position in the development of small-scale biomass (Kammen, 1999) and wind energy systems (Byrne, *et al.,* 1988), and further progress could be made if linkages existed between large-scale projects (such as this loan, or the recently completed GEF PV/wind loan) and small-scale initiatives. The linkages and synergies between large-scale and small-scale power production and the provision of non-electricity based services (e.g. water pumping, mechanical tasks, cooking and space-heating) are not well documented or realized by many policy makers. Even when direct technology transfer between these scales is not practical, often the institutional advances and learning by staff-members transfers directly, bringing down the transaction and training costs for new RET-based projects. An ADB or GEF publication highlighting these opportunities would be an important and useful document[84].

Additional methods, for this or future projects, could even involve the establishment of net-metering schemes to encourage smaller-scale clean power production. The reason to consider this from the outset – even though this loan is for three specific wind farms – is that this wind energy loan is designed to remove institutional barriers, and to encourage greater commercial installation and use of renewables. Multiple benefits are needed to encourage the emergence of this commercial RET sector. The opportunity to develop renewable energy power plants that sell power back to the grid at a reasonable price[85] should be encouraged. The potential for net-metered energy sales would assist new power producers in efforts to encourage adoption of renewable energy systems by their customers (households, municipalities, private and parastatal industries)[86].

Project Summary, page v:
The allocation of resources for 30 months of consulting should be structured to encourage independent analytic capacity within China, as well as within the international community. One means to do this would be to offer some consulting contracts for partnerships between consultants that link PRC-based and international individuals. The ADB could, for example, utilize its roster of experts to create these partnerships.

Main Report, page 21 (paragraph 32):

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[84]The paper by Duke, *et al*, (2000) demonstrates the utility of this sort of analysis. Their paper covered only one topic, amorphous and crystalline photovoltaic cells and systems.

[85]Some questions have been raised about the calculations, and assumptions that go into setting the state catalog price versus the guidance price.

[86] In a critical point, this diversification of power production and sales need not come as a detrimental challenge to tehe State Development and Planning Commission (SDPC), but rather as a means to keep costs down, and to foster better accounting and the dissemination of best technical, financial, and managerial practices.

Attention needs to be paid to any problems that may arise in the power purchase agreements for the wind farms under the 1999 World Bank/GEF

Main Report, page 25 (paragraph 39ff)
While the ADB investments in the energy sector in China have been found to be well planned and executed, renewable energy efforts are largely new, and require significant technical, economic, managerial, and institutional innovations (particularly if they are to be accompanied by the growth a new, sustainable, commercial sector). Thus, past performance may not be a good measure of future success in this area, and even for past projects, the Main Document notes that only 2 of 14 ADB financed projects have been completed. For this reason, it is particularly important for there to be independent and external input, consultations, and review of the progress of this and other RET projects. Site visits and independent economic analysis are both necessary parts of that process. It is recommended that this and other RET investment projects receive not only initial outside review – such as this document – but also periodic on-site discussion and review. The need for not only outside review, but outside training opportunities for the staff of these projects, is crucial to build sufficient human resources and institutional strength to plan, implement, and push for future RET projects. This reviewer could be available for some of that process, particularly as he has also reviewed the World Bank/GEF solar photovolatic and wind farm project.

Main Report, page 26, paragraph 40:
The downgrading of the Fuel Conversion Project to 'unsuccessful' is a concern. A more extensive review and presentation of the failures there, and the lessons for the current project should be included. This is particularly true because of the note that capacity building and training have not always worked as desired.

Main Report, page 37 (item iii.e):
The project team, if they have not done so already, should review the significant problems encountered in the NFFO and evaluate these in the context of implementation in the PRC. While the NFFO has many theoretically appealing features, implementation in a non-competitive, or partially-competitive market (as is likely in the PRC in the near and medium-term) has been shown to be a weak point of this plan (see, for example, the recent report issued by the Renewable Energy Policy Project: www.repp.org).

Main Report, page 42, paragraph 65:
The traiff reduction plan is certainly important. The text of paragraph 65 makes no clear statement of what the ADB expects from the PRC in terms of tariff reform, and what level of action would be considered acceptable, and under what time-frame. This should be made explicit.

Main Report, Page 53, paragraph 86 and Table 3:
Note that while generation and sales costs from the wind farms are quite reasonable, added attention to economic development of independent power producers could, in fact, lower overall energy costs through added diversity and opportunities for net-metered energy installations.

Main Report, page 55, Section J, and Appendix 13:
The environmental impact analysis appears sound, particularly because wind farms in general have been shown to be extremely low impact compared to most other energy generation projects. One area incompletely specified, however is paragraph 92, that outlines the compensation to be provided to the Kazakh herders. A combination of dual use (herding and

turbine) for the land, compensation, and the provision of wind energy-related technical, economic, and managerial training and jobs is recommended.

Main Report, page 56 (Section IV, J.2.a):
The section title 'Pro-Poor Economic Growth' is nonsensical.

GEF Project Note: Response to GEF Project Review Criteria, page 10, Section V.B:
A particularly important, but briefly stated, point is that the ADB anticipates the development and financing of an expanded number and scope of renewable energy projects in the PRC. This welcome statement could have major impact through the direct reduction in greenhouse gas emissions, but also on the experience with, and economic opportunities for renewable energy dissemination. This, latter, experience-building and capacity developing role is critical to building renewable energy markets in the PRC and beyond. [This point is expanded greatly in the *Project Summary*, discussion of the need for ADB support of a larger 'Renewable Energy Pipeline' initiative.]

Appendix 11, Tables 1 – 9:
These are exceedingly long-term forecasts given the state of the international energy economy, and the demand growth rates anticipated for China. At minimum, an uncertainty band should be developed based on evaluations of past forecast accuracy in the Chinese energy sector. This is a simple procedure, based on testing prior forecasts (for dates already past) versus the actual values (Shlykahter, *et al,* 1994). The history of forecasts in the energy sectors of several nations has found this to be a minimum uncertainty range that should be used in this sort of forecasting.

Appendix 13, page 4, Tables 1 – 4:
These calculations do not appear to take into account personnel training in advance of wind farm operation, nor the desirable component of training opportunities for personnel from other provinces to intern at the three wind farms so that the expertise can be disseminated.

Appendix 14:
It is unclear how the global benefit of the EIRR Monte Carlo analysis was conducted. Presumably this results from the chance that a carbon tax and global trading market was implemented during the active life of the wind farms. If so, this should be clarified, and if not, the basis or this global benefit should be more clearly specified.

References:

Byrne, J. Shen, B. and Wallace, W. (1998) "The economics of sustainable energy for rural-development - A study of renewable energy in rural China", *Energy Policy*, **26**, 45 – 54.

Dockery, D. W. *et al.*, (1989) *American Review of Respiratory Disease* **139**, 587 - 594 .

Dong, F., Lew, D., Li, P., Kammen, D. M., and Wilson, R. (1998) "Strategic options for reducing CO_2 in China: Improving energy efficiency and Using Alternatives to fossil fuels" in *Energizing China: Reconciling Environmental Protection and Economic Growth*, Eds. M. B. McElroy, C. P. Nielsen, & P. Leiden, (Cambridge, MA: Harvard University Press), 119 – 166.

Duke, R. and Kammen, D. M. (1999) "The economics of energy market transformation programs," *The Energy Journal*, **20**(4): 15 - 64.

Duke, R. D., Graham, S., Hankins, M., Jacobson, A., Kammen, D. M., Khisa , D., Kithokoi, D., Ochieng, F., Osawa, B., Pulver, S. and Walther. E. (2000*) Field Performance Evaluation of Amorphous Silicon (a-Si) Photovoltaic Systems in Kenya: Methods and Measurements in Support of a Sustainable Commercial Solar Energy Industry*, Energy Sector Management Assistance Program (ESMAP) Report (The World Bank: Washington, DC), in press.

Ezzati, M. and Kammen, D. M. (2000) "An exposure-response relationship linking indoor air pollution and acute respiratory illness from cooking fuels in rural Kenya", submitted to *Nature*.
[This paper is available upon request.]

Ezzati, M., Saleh, H., and Kammen, D. M. (2000) "The contributions of emissions and spatial microenvironments to exposure to air pollution from biomass combustion in Kenya", *Environmental Health Perspectives* , **8 (9)**, 1 – 7.

Inversin, Allen R. (1996) New Designs for Rural Electrification: Private Sector Experiences in Nepal, NRECA, International Programs Division.

Kammen, D. M. (1999) "Bringing power to the people: Promoting appropriate energy technologies in the developing world", *Environment*, **41 (5)**, 10 – 15 & 34 - 41.

Pope, C. A. III, Dockery, D. W., Spengler, J. D., and Raizenne, M. E. (1991) *American Review of Respiratory Disease* **144**, 668 - 674 .

Shlyakhter, A. I., Kammen, D. M., Broido, C. and Wilson, R. (1994) "Quantifying credibility of energy projections from trends in past data: the U. S. energy sector," *Energy Policy*, **22**, 119 - 131.

Xu, X., *et al* (1998*)* "Exposure to indoor air pollution and health impacts in five Chinese cities" *Energizing China: Reconciling Environmental Protection and Economic Growth*, Eds. M. B. McElroy, C. P. Nielsen, & P. Leiden, (Cambridge, MA: Harvard University Press), 27 - 56.

Sent to:

Edu Hassing	ehassing@adb.org
France Holgado	fholgado@adb.org, njahmad@adb.org
Richard Hosier	richard.hosier@undp.org

RESPONSE TO STAP REVIEW

I. General Comments

- Use of Benefit Transfer Method (paragraph 3, page 3)

  The ADB's *Workbook on Economic Evaluation of Environmental Impacts* uses the Benefit Transfer Method for evaluation. A more sophisticated approach is beyond the scope of the Project.

- Incremental cost calculation is incomplete (paragraph 5, page 3)

  An incremental cost appendix is presented in full as Appendix 16.

- Adoption of the RPS is deemed central to this loan, no measures are taken to tie the loan directly to progress in that area (paragraph 2, page 4)

It is agreed that this is important for promoting wind power development in the PRC. However, for the Project to be viable, adoption of the RPS is not required. Mechanisms for introduction of RPS will be developed under the Government's Strategic Partnership for Renewable Energy Development with assistance from GEF, World Bank, and ADB.

- Development of a significant standing capacity for RET analysis and promotion within the ADB would also help the Government of the PRC in its anti-corruption campaign (paragraph 3, page 4)

The need for increasing institutional strength within ADB is noted and will be addressed through ADB's proposed Regional Technical Assistance for Promotion of Renewable Energy, Energy Efficiency, and Greenhouse Gas Abatement Projects, which is expected to become operational in the third quarter of 2000.

- Evaluation and enactment of changes in market structure may in many cases be improved by conferences, training sessions outside China, and relatively long-term training courses within China as well as visits by external experts. Added funding is needed to support these activities (paragraph 4, page 4).

  It is envisaged that these activities will be included in activity (vi) for barrier removal and institutional strengthening. However, during Project appraisal, we will review whether there is a need to further expand such activities.

II. Specific Comments

- It appears that the Ministry of Finance will be the source of primary project operational management a broader range of technical and economic oversight is likely to result in superior project implementation, and broader dissemination of the project lessons of widespread applicability of renewable energy options (paragraph 5, page 4).

The Ministry of Finance will be the conduit for sourcing of the funds. The State Development and Planning Commission (SDPC) will be the national coordinating agency for the Project and will involve the State Power Corporation (SP), the State Economic and Trade Commission (SETC), and the Ministry of Science and Technology in the implementation of the Project.

- The reviewer makes certain observations with regard to the financial structure of the loan (paragraphs 2 and 9, page 5).

  - Tie the loan repayment to power production.

  The experience of wind farms in the PRC shows that power purchase agreements (PPAs) based on debt repayment have led to underutilization of available wind power and inefficient operations of wind farms.

  - Repayment rate scheme should be tied to the actual levelized tariffs for each wind farm.

  This is not practical. The tariffs cover all costs plus a reasonable return on equity. All wind farms will have the same relative amount of cash available to service debts; thus a uniform loan repayment scheme is the appropriate option.

  - Greater length of the grace period, or discounts from the ADB interest rate can be granted in response to better economic performance form the wind farms.

    The ADB grace period is determined on basis of the construction period that can reasonably be expected to be required. ADB's interest rates are fixed; however, the impact of the interest rate vis-à-vis the relatively higher risks of the Project needs to be addressed upfront; hence, the contingent grant.

- Attention needs to be paid to any problems that may arise in the power purchase agreements for the wind farms under the 1999 World Bank/GEF.

  Is being done. It is proposed to make availability of power purchase agreements initiated by the concerned parties a condition for loan negotiations.

- Consultations and review of this Project and other RET projects are important (paragraph 4, page 6).

We agree and will monitor the Project and other Projects closely in consultation with the concerned PRC authorities and if required, with assistance from consultants.

- The downgrading of the Fuel Conversion Project to "unsuccessful" is a concern.

The project was exclusively premised on projected economic gains arising from fuel substitution which did not materialize and is therefore not directly relevant for the Project.

- Implementation in a non-competitive, or partially competitive market (as is likely in the PRC in the near and medium-term) has been shown to be a weak point of this plan (paragraph 1, page 7).

  Noted. Matter will be studied further at a national level under the Government's Strategic Partnership for Renewable Energy as well as at the level of the three provinces under the Project through the GEF contribution.

- It should be made more explicit what ADB expects from the PRC in terms of tariff reform for rural consumers (paragraph 2, page 7).

  This will be made more explicit in the final report based on the findings of the ongoing study.

- A combination of dual use (herding and turbine) for the land compensation (to the Kazakh herders), and the provision of wind energy-related technical, economic, and managerial training and jobs is recommended (paragraph 4, page 7).

  In accordance with ADB's *Policy on Indigenous Peoples*, an Ethnic Minority Development Plan will be prepared that will address these issues.

- Appendix 11, Tables 1-9. An uncertainty band should be developed for the long-term energy forecasts (paragraph 7, page 7).

  In accordance with ADB practice, the forecasts were made on a conservative basis.

- Appendix 13, page 4, Tables 1-4. The calculations should take into account personnel training in advance of wind farm operation (paragraph 2, page 8).

  Training of personnel will be provided by the main contractors for one year following commissioning and is included the cost estimates.

- Appendix 14. It is unclear how the global benefit of the EIRR Monte Carlo analysis was conducted (paragraph 3, page 8).

  In the final report, the Monte Carlo analysis will be conducted for the base case EIRR only (without global environmental benefits).

III. Other Comments

In addition, the reviewer proposes a number of studies including:

- Analysis of the role of market transformation opportunities through the support of renewable energy options in cases where ADB funds could improve the future market through volume-based price decreases.

- Options for building renewable energy infrastructure that is both technical and managerial within the international energy development organization, and within the commercial sectors of many nations.

- Analysis of the linkages and synergies between large-scale and small-scale power production, including opportunities for net-metered energy installations.

This has been noted and will be taken into consideration for study under the ADB's proposed Regional Technical Assistance for Promotion of Renewable Energy, Energy Efficiency, and Greenhouse Gas Abatement Projects.

Appendix 18, page1

INTERNATIONAL DEPARTMENT
MINISTRY OF FINANCE
Sanlihe, Xicheng District
Beijing 100820 People's Republic of China

MOF

中华人民共和国财政部
国 际 司
中国北京三里河南三巷3号100820

June 26, 2000

Mr. Nessim J. Ahmad
GEF Focal Point
Asian Development Bank

ADB/GEF Wind Power Development Project

Mr. Ahmad:

Wind Power is an environment-friendly and sustainable energy. This ADB/GEF wind power project can assist the Government to achieve its agenda of renewable energy Partnership Program. It can also provide experiences and lessons to both central and provincial electric administration to further improve their wind power development program. Meanwhile, the project has global environment benefits, which is eligible to GEF financing.

Therefore, I would like to endorse this wind power project to request GEF assistance and incorporate it to the pipeline.

Best regards.

Sincerely yours,

(Jinlin Yang)
Operational Focal Point for China

Tel: (86-10) 6855 1133, 6855 1183 Fax: (86-10) 6855 1183, 6855 1125